SCIENTIFIC SIDE-LIGHTS

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ILLUSTRATING THOUSANDS OF TOPICS BY SELECTIONS FROM STANDARD WORKS OF THE MASTERS OF SCIENCE THROUGHOUT THE WORLD, WITH COMPREHENSIVE INDEXES EMBRACING THIRTY THOUSAND TOPICS AND CROSS-REFERENCES, AND MAKING ALL MATTERS CONTAINED IN THE VOLUME INSTANTLY AVAILABLE FOR ILLUSTRATIVE USE :: :: :: :: :: ::

COMPILED BY

JAMES C. FERNALD

Associate Editor of the "Standard Dictionary"; Editor of the "Students' Standard Dictionary"; "English Synonyms, Antonyms, and Prepositions"; Etc.

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INTRODUCTORY

THE material in this book can be absolutely relied upon. In using it, the student may be sure that he is dealing with master minds, each of whom has made a specialty of the science of which he treats. The editor has kept steadily in view the duty of a compiler. He has refrained from making digests, compends, or summaries of the works reviewed. He has not undertaken to advance any opinion, theory, or creed, but simply to give the fairest possible picture of the present state of science consistent with the primary purpose of the work as a volume of illustrations. Where eminent men differ in opinion, conflicting views have been allowed expression, leaving the name and authority of each author to answer for his own statements. The recording of a scientific opinion is not its advocacy, and that even leaders in science may well change their views with advancing knowledge is abundantly shown in the selections given, and freely admitted by the foremost among them.

In obedience to the primary and controlling purpose of scientific illustration, whatever in science can throw a "side-light" upon some intellectual, moral, political, industrial, social, or religious truth has been seized wherever found. The titles and location of topics are thus not what would be found in a scientific hand-book, which would place all matter treating of glaciers under *glacier*, of oxygen under *oxygen*, of volcanoes under *volcano*, etc. It is not primarily for the astronomical, geological, chemical, or other scientific teachings that the selections have been made, but for some truth relating to humanity, which they illustrate.

At the same time, it is believed that the selections will be found of exceeding interest for their own sake, and that they will open to many readers vistas of the wide reach of science, such as their special studies have not previously brought to their view. The minister, the teacher, or the busy worker in any profession, even if he devotes his spare time to science, can scarcely hope for extensive knowledge in more than some one of its many departments. Through these pages flashes of light will come to him from all, and he will thus gain a fuller view of the grand unity toward which all are tending.

Of the use of scientific illustrations in speaking or writing, it may be said that they are in harmony with the spirit of the age, which is preeminently scientific; that they have not the hackneyed character of the numerous popular anecdotes or of the stock illustrations long current in classic literature, and that they especially impress the thoughtful mind, as dealing with facts. However theories may change, the movements of suns and planets, the combinations of chemistry, the fossils and strata of geology, the properties of heat, light, and sound, the marvels of electricity, and the infinitesimal world of the microscope are facts, ascertained and demonstrable. The mind is there upon sure ground, and the use of such facts in illustration gives a sense of certainty and reality to the thoughts they are employed to illustrate.

The selections here given are not from works on so-called "popular science," where the element of popularity often quite swamps the scientific, where uncertified facts are given on the testimony of anonymous witnesses, and where the suspicion is often inevitable that the occurrence happened for the sake of the illustration. This work is based upon the belief that the essentials of science are simple enough for the untrained mind, and that whatever of abstruseness it contains is in processes or in their necessary technical terms, and that there are none who can state the essentials more clearly than those who know them most thoroughly at first hand—the leading specialists in the

various departments. An examination of the Index of Authors will show how high is the standing of the writers from whom the quotations are made, and a study of the selections will show how simple and lucid are their expositions of scientific truth. The reader cannot fail to be impressed also with the exceeding felicity of language, the beautiful descriptions of natural scenery, the sympathy with all the grandeur and beauty of Nature, and the wide outreach of thought and aspiration with which these extracts abound.

For each selection a number of topics for illustrative use are commonly suggested in the headlines, while still others are indicated in the various indexes; but so multiform are the relations of scientific truth to all other truth, that the thoughtful reader will constantly perceive new uses and adaptations of the same scientific fact. This suggestiveness of these extracts, reaching beyond anything that can be specified in set phrases, will be found among the most valuable qualities of this collection. While each selection is complete in itself and ready for immediate use, without reference to any other work, it will be found also of value as a guide to the sources from which other material of interest and value may be obtained; for these extracts, tho most carefully made, are yet but specimens of the riches to be found in the various works from which they are taken. The student will almost certainly find himself impelled to seek a fuller knowledge of some at least of the subjects presented in the volumes themselves of which these extracts form a part.

In the choice of authors to be quoted, the editor has been guided, not merely by his own opinion, but by the valued advice of eminent scholars, as Marcus Benjamin, A.M., Ph.D, F.C.S., Editor U. S. Nat. Museum, Washington, D. C.; Arthur Elmore Bostwick, Ph.D., New York Public Library, New York City; Professor Charles Sumner Dolley, M.D., Philadelphia, Pa.; Professor Albert Smith Bickmore, Ph.D., American Museum of Natural History, New York; Louis Pope Gratacap, Ph.B., American Museum of Natural History, New York; Professor Frank Hall Knowlton, Ph.D., U. S. Nat. Museum, Washington; Professor George Perkins Merrill, Ph.D., U. S. Nat. Museum, Washington, D. C.; Professor Theophil Mitchell Prudden, M.D., LL.D., Columbia University; Professor Frederick Starr, Ph.D., University of Chicago; Isaac Kauffman Funk, D.D., LL.D., Editor in Chief of Funk & Wagnalls STANDARD DICTIONARY, New York; Professor Edward Richard Shaw, Ph.D., New York University; Henry Newlin Stokes, Ph.D., U. S. Geol. Survey, Department of the Interior, Washington, D. C.; Professor Nathaniel Southgate Shaler, D.S., Harvard University—whose aid it is a pleasure here gratefully to acknowledge.

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to use, and whose courtesy and kindness it will always be a pleasure to remember: to D. Appleton & Co., of New York, whose International Library of Science and Modern Science Series have been of especial service and are to be commended as placing a great amount and variety of admirably selected material within the reach of the American or English reader in his own language; to the American Book Co., the Clarendon Press, the Columbia University Press, Wm. O. Allison, A. L. Burt, Dodd, Mead & Co., Doubleday, Page & Co., Fords, Howard & Hulbert, Harper & Brothers, Henry Holt & Co., the Humboldt Publishing Co., Longmans, Green & Co., James Pott & Co., G. P. Putnam's Sons, Charles Scribner's Sons, Sheldon & Co., John Wiley & Sons, and Wm. Wood & Co., of New York; to Ginn & Co., Houghton, Mifflin & Co, and Little, Brown & Co., of Boston; to the American Baptist Publication Society, the Henry Altemus Co., and J. B. Lippincott & Co., of Philadelphia; to the Schulte Publishing Co., of Chicago; to A. & C. Black, Bell & Sons, Chapman & Hall, J. M. Dent & Co., Harper & Brothers, Kegan Paul, Trench, Trübner & Co., Swan, Sonnenschein & Co., of London. Individual favors and courtesies more than can be here enumerated, but all of which are gratefully remembered, have aided in the preparation of the work.

JAMES C. FERNALD.

New York, December, 1902.

KEY TO ABBREVIATIONS

α—Alpha, designating a special star of group; thus, α (alpha) *Centauri* is the most brilliant star of the constellation Centaurus or Centaur. Other Greek letters are at times similarly used.
A.—D. Appleton & Co.
A. & S.—A. C. Armstrong & Son.
A.B.Co.—American Book Co.
A.B.P.S.—American Baptist Publication Society.
A. D. L. V.—Anleitung zur deutschen Landes und Volksforschung, Alfred Kirchof, editor.
Bell.—Bell & Sons.
Bl.—A. & C. Black.
Burt.—A. L. Burt.
C. & H.—Chapman & Hall.
Cl. P.—Clarendon Press.
C. U. P.—Columbia University Press.
D. & McC.—Doubleday & McClure Co.; Doubleday, Page & Company.
D. M. & Co.—Dodd, Mead & Co.
D. Z. S. F. Deutsche-Zeit und Streit-fragen.
F. H. & H.—Fords, Howard & Hulbert.
F. & W.—Funk & Wagnalls Co.
G. & Co.—Ginn & Co.
G. & L.—Gould & Lincoln.
G. P. P.—G. P. Putnam's Sons.
H.—Harper & Bros.
H. Al.—Henry Altemus.
H. H. & Co.—Henry Holt & Co.
H. M. & Co.—Houghton, Mifflin & Co.
Hum.—Humboldt Publishing Co.
J. P.—James Pott & Co.
J. W.—John Wiley & Sons.
K. P. & Co.—Kegan Paul & Co.; Kegan Paul, Trench, Trübner & Co.
L.—J. B. Lippincott & Co.
L. B. & Co.—Little, Brown & Co.
L. G. & Co.—Longmans, Green & Co.
R. Ct.—Robert Carter.
S.—Charles Scribner's Sons.
S. G. W. V.—Sammlung gemeinverstandlicher wissenschaftlicher Vortrage, R. Virchow and F. von Holtzendorff, Editors.
Sch. P. C.—Schulte Publication Co.
Sh. & Co.—Sheldon & Co.
Sm. Inst.—Smithsonian Institution.
Son. & Co.—Sonnenschein & Co.
U. P.—University Press.
W. L. A.—W. L. Allison & Co.
W. W.—William Wood & Co.

SCIENTIFIC SIDE-LIGHTS

1. ABERRATION OF LIGHT—*Apparent Motion of Stars in Space Due to Motion of the Earth.*—Bradley . . . noticed that the fixed stars did not really appear to be fixed, but that they describe little orbits in the heavens every year. The result perplexed him. . . . He was one day upon the Thames in a boat, and noticed that as long as his course remained unchanged, the vane upon his masthead showed the wind to be blowing constantly in the same direction, but that the wind appeared to vary with every change in the direction of his boat. "Here," as Whewell says, "was the image of his case. The boat was the earth, moving in its orbit, and the wind was the light of a star." . . . You will immediately understand the meaning of Bradley's discovery. Imagine yourself in a motionless railway-train, with a shower of rain descending vertically downwards. The moment the train begins to move the raindrops begin to slant, and the quicker the motion of the train the greater is the obliquity. In a precisely similar manner the rays from a star vertically overhead are caused to slant by the motion of the earth through space. Knowing the speed of the train, and the obliquity of the falling rain, the velocity of the drops may be calculated; and knowing the speed of the earth in her orbit, and the obliquity of the rays due to this cause, we can calculate just as easily the velocity of light.—TYNDALL *Lectures on Light*, lect. 1, p. 22. (A., 1898.)

2. ABRASION OF ROCKS BY GLACIERS—*Marks of Ice That Melted Ages Ago.*—In the first place, we have to consider the singular abrasion of the surfaces over which the glacier has moved, quite unlike that produced by the action of water. We have seen that such surfaces, wherever the glacier-marks have not been erased by some subsequent action, have several unfailing characteristics: they are highly polished, and they are also marked with scratches or fine *striæ*, with grooves and deeper furrows. Where best preserved, the smooth surfaces are shining; they have a luster like stone or marble artificially polished by the combined friction and pressure of some harder material than itself until all its inequalities have been completely leveled and its surface has become glossy. Any marble mantelpiece may serve as an example of this kind of glacier-worn surface.—AGASSIZ *Geological Sketches*, ser. ii, p. 34. (H. M. & Co., 1896.)

3. ——— *Rocks Are Cut by Existing Glaciers.*—At the lower end, and along the sides of many Alpine glaciers, the ice charged with sand and stones may be seen in direct contact with the smooth, polished, and striated rock surfaces. Below glaciers that have recently retreated, and where the surface is still bare of vegetation, records similar to those just mentioned may be observed in thousands of localities. The same is true, also, over vast regions that are known to have been formerly glaciated; while on adjacent areas, where the conditions are similar, excepting that they were not occupied by ice, the peculiar and not easily mistaken evidences of ice abrasion are lacking. We have, therefore, both positive and negative evidence pointing to the conclusion that glaciers abrade the rocks over which they flow.—RUSSELL *Glaciers of North America*, int., p. 19. (G. & Co., 1897.)

4. ABSENCE OF MIND—*Newton and the Egg.*—Always preoccupied with his profound researches, the great Newton showed in the ordinary affairs of life an absence of mind which has become proverbial. It is related that one day, wishing to find the number of seconds necessary for the boiling of an egg, he perceived, after waiting a minute, that he held the egg in his hand, and had placed his seconds watch (an instrument of great value on account of its mathematical precision) to boil!—FLAMMARION *Popular Astronomy*, bk. ii, ch. 1, p. 93. (A.)

5. ACCIDENT CONFIRMS SUPERSTITION—*Indian's Prognostication of Calamity—A Hunter's Omen.*—The effect of accidental occurrences upon an uneducated mind, in engendering superstition, is a subject which has often been dwelt upon, and the difficulty of eradicating the same—as may be judged of by the following accident which came under the observation of Mr. T. B.

Lloyd and the author, in 1873, when traveling in Newfoundland—will be easily appreciated. At the time to which I refer, my companion was bringing a canoe down the rapids below the Grand Pond in a country which is practically uninhabited, and where an Indian trapper would perhaps be the only person met with, and this not more than once a year. Whilst shooting the rapids one of the Indians, Reuben Soulian, shot at a deer passing up one bank of the river. That the deer had been hit was testified by a trail of blood which bespattered the rocks. Subsequently several more shots were fired, and it was believed by all that the deer was killed. Soulian quickly followed the animal to the spot where it was supposed to have fallen. Some time after he returned, having failed to find any trace of the animal. He was greatly agitated, but eventually became melancholy, saying that the sudden disappearance of the animal was a sure sign that some of his relations had suddenly died. About two hours afterwards Mr. Lloyd's party met with a party of Indians coming up the river, the first they had seen for four weeks, who told them that Soulian's sister had just died on the coast. —MILNE *Earthquakes*, ch. 18, p. 306. (A., 1899.)

6. ACCIDENT, HAPPY—*Measurement of Etna—Agreement of Masters.*—In 1815, Captain Smyth ascertained, trigonometrically, that the height of Etna was 10,874 feet. The Catanians, disappointed that their mountain had lost nearly 2,000 feet of the height assigned to it by Recupero, refused to acquiesce in the decision. Afterwards, in 1824, Sir J. Herschel, not being aware of Captain Smyth's conclusions, determined by careful barometrical measurement that the height was 10,872½ feet. This singular agreement of results so differently obtained was spoken of by Herschel as "a happy accident"; but Dr. Wollaston remarked that "it was one of those accidents which would not have happened to two fools."—LYELL *Principles of Geology*, ch. 25, p. 396. (A., 1854.)

7. ACCIDENT LEADS TO IMPORTANT INVENTION—*Electric Motor the Result of a Workman's Mistake.*—At an industrial exhibition in Vienna, in 1873, a number of Gramme machines were being placed in position, in order to exemplify the various uses to which the invention might be put as an electric generator, when there occurred one of those singularly fortunate accidents which have again and again played so prominent a part in the history of industrial progress. In making the electrical connections to one of these machines which had not as yet been belted to the engine-shaft, a careless workman attached to it by mistake a pair of wires which were already connected with another dynamo machine which was in rapid motion. To the amazement of this worthy artisan the second machine commenced to revolve with great rapidity in a reverse direction. Upon the attention of M. Gramme being directed to this phenomenon, he at once perceived that the second machine was performing the function of a motor, and that what was taking place was an actual transference of mechanical power through the medium of electricity. This singularly opportune occurrence, being commented upon in the scientific journals, led to the instant recognition of the true place of the electric motor in the domain of mechanics.—POPE, in *Electricity in Daily Life*, p. 46. (S., 1893.)

8. ACCIDENT LED TO THE DISCOVERY OF THE EARTH-CIRCUIT—The possibility of signaling without wires was in a manner forced upon him [Steinheil of Munich]. While he was engaged in establishing his beautiful system of telegraphy in Bavaria, Gauss, the celebrated German philosopher, and himself a telegraph inventor, suggested to him that the two rails of a railway might be utilized as telegraphic conductors. In July, 1838, Steinheil tried the experiment on the Nürnberg-Fürth railway, but was unable to obtain an insulation of the rails sufficiently good for the current to reach from one station to the other. The great conductibility with which he found that the earth was endowed led him to presume that it would be possible to employ it instead of the return wire or wires hitherto used. The trials that he made in order to prove the accuracy of this conclusion were followed by complete success; and he then introduced into electric telegraphy one of its greatest improvements—the earth-circuit.—FAHIE *Wireless Telegraphy*, p. 3. (D. M. & Co., 1900.)

9. ACCIDENT REENFORCES SUPERSTITION—*Profile Portrait Gives Offense to Savages—Artist Endangered.*—Catlin excited great commotion among the Sioux by drawing one of their chiefs in profile. "Why was half his face left out?" they asked; "Mahtocheega was never ashamed to look a white man in the face." Mahtocheega himself does not seem to have taken any offense, but Shonka, The Dog, took advantage of the idea to taunt him. "The Englishman knows," he said, "that you are but *half a man;* he has painted but one-half of your face, and knows that the rest is good for nothing." This view of the case led to a fight, in which poor Mahtocheega was shot; and as ill-luck would have it, the bullet by which he was killed tore away just that part of the face which had been omitted in the drawing. This was very unfortunate for Mr. Catlin, who had great difficulty in making his escape, and lived some months after in fear for his life; nor was the matter settled until both Shonka and his brother had been killed in revenge for the death of Mahtocheega.—AVEBURY *Prehistoric Times*, ch. 14, p. 505. (A., 1900.)

10. ACCIDENT, SEEMING, LEADS TO DISCOVERY OF URANUS—*Result of Sir William Herschel's Exhaustive Study.*—Altho Uranus was discovered by accident, it will not be thought that on that account small credit should be given to Sir W. Herschel, the astronomer, to whose redoubtable telescope this planet fell as a spoil. The accident was one which could not have happened but to an enthusiast in astronomical researches. He had penetrated into the star depths again and again with telescopes of his own construction, engaged in the attempt to solve problems of the utmost difficulty, when one night this new orb swept into his ken.—PROCTOR *Expanse of Heaven*, p. 115. (L. G. & Co.)

11. ACCIDENT UTILIZED BY MAN OF SCIENCE—*Darwin Led to the Study of Insectivorous Plants—Great Destruction of Insects by Drosera or Sundew.*—During the summer of 1860, I was surprised by finding how large a number of insects were caught by the leaves of the common sundew *(Drosera rotundifolia)* on a heath in Sussex. I had heard that insects were thus caught, but knew nothing further on the subject. I gathered by chance a dozen plants, bearing fifty-six fully expanded leaves, and on thirty-one of these dead insects or remnants of them adhered; and, no doubt, many more would have been caught afterwards by these same leaves, and still more by those as yet not expanded. On one plant all six leaves had caught their prey; and on several plants very many leaves had caught more than a single insect. On one large leaf I found the remains of thirteen distinct insects. Flies *(Diptera)* are captured much oftener than other insects. The largest kind which I have seen caught was a small butterfly *(Cœnonympha pamphilus)*; but the Rev. H. M. Wilkinson informs me that he found a large living dragon-fly with its body firmly held by two leaves. As this plant is extremely common in some districts, the number of insects thus annually slaughtered must be prodigious. Many plants cause the death of insects, for instance the sticky buds of the horse-chestnut, without thereby receiving, as far as we can perceive, any advantage; but it was soon evident that Drosera was excellently adapted for the special purpose of catching insects, so that the subject seemed well worthy of investigation.—DARWIN *Insectivorous Plants*, ch. 1, p. 1. (A., 1900.)

12. ACCIDENT YIELDS DISCOVERY TO TRAINED OBSERVER—*Goodyear First Vulcanized India-rubber by Chance.*—Goodyear, the sagacious and persevering investigator into the properties and uses of caoutchouc or india-rubber, had long inquired after some agent in nature which would remove from the substance in question its special sensibility to cold and heat, and make it in effect a new material. He discovered this long-desired agent in the most casual way. "In one of those animated conversations so habitual to him, in reference to his experiments, a piece of india-rubber combined with sulfur, which he held in his hand as the text of all his discourses, was by a violent gesture thrown into a burning stove near which he was standing. When taken out, after having been subjected to a high degree of heat, he saw—what it may be safely affirmed would have escaped the notice of all others—that a complete transformation had taken place, and that an entirely new product, since so felicitously termed 'new metal,' was the consequence." (Decision of the U. S. Commissioner of Patents.) . . . The eye of Goodyear was quickened by the watching and waiting of years to that sagacity which was able to see in the piece of refuse rubber casually discharged from the fire an answer to the question with which his mind had so long been burdened.—PORTER *Human Intellect*, pt. iii, ch. 8, p. 490. (S., 1899.)

13. ACCOMPLISHMENT OF THE IMPOSSIBLE—*Chemistry of Sun and Stars Revealed—Scientists' Predictions Falsified.*—Resuming in a sentence what has been already explained, we find that the prismatic analysis of the heavenly bodies was founded upon three classes of facts: First, the unmistakable character of the light given by each different kind of glowing vapor: secondly, the identity of the light absorbed with the light emitted by each; thirdly, the coincidences observed between rays missing from the solar spectrum and rays absorbed by various terrestrial substances. Thus, a realm of knowledge, pronounced by Morinus in the seventeenth century, and no less dogmatically by Auguste Comte in the nineteenth, hopelessly out of reach of the human intellect, was thrown freely open, and the chemistry of the sun and stars took its place among the foremost of the experimental sciences.—CLERKE *History of Astronomy*, pt. ii, ch. 1, p. 174. (Bl., 1893.)

14. ACCUMULATION OF ETHICAL FORCES—*Advance Must Be Unbroken.*—One must first learn, unmoved, looking neither to the right nor left, to walk firmly on the straight and narrow path, before one can begin "to make oneself over again." He who every day makes a fresh resolve is like one who, arriving at the edge of the ditch he is to leap, forever stops and returns for a fresh run. Without unbroken advance there is no such thing as accumulation of the ethical forces possible, and to make this possible, and to exercise us and habituate us in it, is the sovereign blessing of regular work.—BAHNSEN *Beiträge zur Characterologie*, quoted by JAMES in *Psychology*, vol. i, ch. 4, p. 124. (H. H. & Co., 1899.)

15. ACCUMULATION OF EXCITEMENTS—A stimulus which would be inadequate by itself to excite a nerve-center to effective discharge may, by acting with one

or more other stimuli (equally ineffectual by themselves alone) bring the discharge about. The natural way to consider this is as a summation of tensions which at last overcome a resistance. The first of them produce a "latent excitement," or a "heightened irritability"—the phrase is immaterial so far as practical consequences go; the last is the straw which breaks the camel's back.—JAMES *Psychology*, vol. i, ch. 3, p. 82. (H. H. & Co., 1899.)

16. ACCUMULATION OF SMALL IMPULSES — *Great Results.* — Extraordinary effects are produced by the accumulation of small impulses. Galileo set a heavy pendulum in motion by the well-timed puffs of his breath. Ellicot set one clock going by the ticks of another, even when the two clocks were separated by a wall. TYNDALL *Fragments of Science*, vol. i, ch. 22, p. 444. (A., 1900.)

17. ACCURACY OF ANCIENT BUILDERS—*Orientation of Great Pyramid—Exactness Not Attainable by Compass.*—It has been frequently maintained that the orientation of the great pyramid is such as to indicate, with reasonable probability, that the compass-needle was used in establishing the positions of its faces.

The difficulty with this supposition is that the pyramid is, in fact, placed with too great accuracy for the work to be done even by the best modern compass. Its sides face astronomically the north, south, east and west; not to the cardinal points of the compass, but to the azimuthal direction of the earth's axis and to a line at right angles thereto. The compass, however, is subject to variations, due to regular daily, monthly, yearly, and centennial changes in the earth's magnetic field, which controls it. Hence, the task of figuring backward the probable position of the needle at the time of the building of the pyramid—a period which is in doubt—might well cause despair in the most skilful investigator of terrestrial magnetism; for, in the least interval which has elapsed, the needle has probably swung over large angles from the true north, back and forth many times. But, granting such a possibility, still it may be safely questioned whether the most accomplished surveyor or topographical engineer of to-day could run the lines of the pyramid faces, by the aid of the best modern compass, with no greater error than 19′ 58″, which the French Academy, in 1799, determined to be the entire amount of variation of these faces from the true astronomical direction. —PARK BENJAMIN *Intellectual Rise in Electricity*, ch. 3, p. 57. (J. W., 1898.)

18. ACCURACY OF DETAIL — *The Charm Alike of Science, Literature, and Art.*—In the sphere of natural investigation, as in poetry and painting, the delineation of that which appeals most strongly to the imagination, derives its collective interest from the vivid truthfulness with which the individual features are portrayed.—HUMBOLDT *Cosmos*, vol. i, int., p. 34. (H., 1897.)

19. ACCURACY OF MODERN ASTRONOMICAL INSTRUMENTS—*All the Light Gathered by a Two-foot Lens Concentrated on a Pin-point.*—The revolving dome above, the great tube beneath, its massive piers, and all its accessories are only means to carry and direct the great lens at the further end [of the equatorial telescope at Washington], which acts the part of the lens in our own eye, and forms the image of the thing to be looked at. Galileo's original lens was a single piece of glass, rather smaller than that of our common spectacles; but the lens here is composed of two pieces, each twenty-six inches in diameter, and collects as much light as a human eye would do if over two feet across. But this is useless if the lens is not shaped with such precision as to send every ray to its proper place at the eye-piece, nearly thirty-five feet away; and, in fact, the shape given its surface by the skilful hands of the Messrs. Clark, who made it, is so exquisitely exact that all the light of a star gathered by this great surface is packed at the distant focus into a circle very much smaller than that made by the dot on this *i*, and the same statement may be made of the great Lick glass, which is three feet in diameter—an accuracy we might call incredible were it not certain. It is with instruments of such accuracy that astronomy now works.—LANGLEY *The New Astronomy*, ch. 5, p. 122. (H. M. & Co.)

20. ACTION A CELESTIAL LAW—*Every Star in Motion.*—So far as observation has extended very few stars in the heavens have unchanging apparent positions. It is highly probable that in reality every star is in motion.—PROCTOR *Expanse of Heaven*, p. 282. (L. G. & Co., 1897.)

21. ACTION AND REACTION—*Increase of Magnetic Power—Progress of Scientific Discovery.*—The aspects of Nature provoke in man the spirit of inquiry. As the eye is formed to see, and the ear to hear, so the human mind is formed to explore and understand the basis and relationship of natural phenomena. A modern discovery illustrates the manner in which our present mastery over Nature has been obtained. We start with a magnet of infinitesimal power, which gives rise to electric currents of infinitesimal strength. These react upon the magnet, exalt its attractive and repulsive forces, thus enabling it to produce stronger currents, which again react upon and enhance the power of their source. Thus we rise from an origin too feeble to produce the slightest spark or gleam, to an energy competent to produce the solar brilliancy of the electric light. In a similarly small way the human mind began its operations among the powers of Nature, winning first a little

knowledge and a little strength, and then turning the knowledge and the strength so won back upon Nature, with the view of winning more. Action and reaction have thus gone on from prehistoric ages to the present time. The result is that stored body of scientific knowledge, and that developed power of scientific investigation, which have revolutionized philosophy, and begotten those marvels of practical science in the midst of which we dwell.—TYNDALL *Heat a Mode of Motion,* lect. 1, p. 1. (A., 1900.)

22. ACTION A NECESSITY TO CLENCH GOOD RESOLUTION—Seize the very first possible opportunity to act on every resolution you make, and on every emotional prompting you may experience in the direction of the habits you aspire to gain. It is not in the moment of their forming, but in the moment of their producing motor effects, that resolves and aspirations communicate the new "set" to the brain. No matter how full a reservoir of maxims one may possess, and no matter how good one's sentiments may be, if one have not taken advantage of every concrete opportunity to act, one's character may remain entirely unaffected for the better.—JAMES *Talks to Teachers,* ch. 8, p. 69. (H. H. & Co., 1900.)

23. ACTION, CONTINUOUS, OF EARTH-BUILDING FORCES—*Slow Upheaval and Subsidence of Lands Now Taking Place.*—Recent observations have disclosed to us the wonderful fact that not only the west coast of South America, but also other large areas, some of them several thousand miles in circumference, such as Scandinavia, and certain archipelagoes in the Pacific, are slowly and insensibly rising; while other regions, such as Greenland, and parts of the Pacific and Indian Oceans, in which atolls or circular coral islands abound, are as gradually sinking. That all the existing continents and submarine abysses may have originated in movements of this kind, continued throughout incalculable periods of time, is undeniable, and the denudation which the dry land appears everywhere to have suffered favors the idea that it was raised from the deep by a succession of upward movements, prolonged throughout indefinite periods. For the action of waves and currents on land slowly emerging from the deep affords the only power by which we can conceive so many deep valleys and wide spaces to have been denuded as those which are unquestionably the effects of running water.—LYELL *Principles of Geology,* ch. 11, p. 170. (A., 1854.)

24. ACTION IMPRESSES MEMORY—*Effort Better than Prompting.*—A curious peculiarity of our memory is that things are impressed better by active than by passive repetition. I mean that in learning by heart (for example), when we almost know the piece, it pays better to wait and recollect by an effort from within than to look at the book again. If we recover the words in the former way, we shall probably know them the next time; if in the latter way, we shall very likely need the book once more.—JAMES *Psychology,* vol. i, ch. 16, p. 686. (H. H. & Co., 1899.)

25. ACTION, INCALCULABLE, OF ELEMENTAL FORCES—*Freaks of Lightning.*—The house [struck by lightning at Montevideo] I saw shortly afterwards. . . . Some of the effects were curious. The paper, for nearly a foot on each side of the line where the bell-wires had run, was blackened. The metal had been fused, and altho the room was about fifteen feet high, the globules, dropping on the chairs and furniture, had drilled in them a chain of minute holes. A part of the wall was shattered as if by gunpowder, and the fragments had been blown off with force sufficient to dent the wall on the opposite side of the room. The frame of a looking-glass was blackened, and the gilding must have been volatilized, for a smelling-bottle, which stood on the chimney-piece, was coated with bright metallic particles, which adhered as firmly as if they had been enameled.—DARWIN *Naturalist's Voyage Around the World,* ch. 3. p. 62. (A., 1898.)

26. ACTION MAY BE REFLEX, NOT INDICATING MIND—If a man has his back broken in such a way as to sever the connection between his brain and lower extremities, on pinching or tickling his feet they are drawn suddenly away from the irritation, altho the man is quite unconscious of the adaptive movement of his muscles; the lower nerve-centers of the spinal cord are competent to bring about this movement of adaptive response without requiring to be directed by the brain. This non-mental operation of the lower nerve-centers in the production of apparently intentional movements is called reflex action, and the cases of its occurrence, even within the limits of our own organism, are literally numberless. Therefore, in view of such non-mental nervous adjustment, leading to movements which are only in appearance intentional, it clearly becomes a matter of great difficulty to say in the case of the lower animals whether any action which appears to indicate intelligent choice is not really action of the reflex kind.—ROMANES *Animal Intelligence,* int., p. 3. (A., 1899.)

27. ACTION OF ANIMALS—*Determined by Memory.*—The action of animals may be determined by memorial ideas, as well as by the corresponding sense-impressions. I often made the following amusing experiment with my own poodle. I had taught him to spring over a stick which I held out at the word "Jump!" One day I called the word out to him without presenting the stick. At first he looked at me in surprise, and then, as I repeated the command, barked impatiently. At last, after I had

given the order several times with a stern face, he decided to make a spring into the air, but barked loudly at me afterwards, as tho to complain of the absolute absurdity of my command. When I had repeated the experiment a number of times, the animal came to respond at once by springing into the air, but never failed to protest by growling and barking. The word of command aroused the memorial idea, and this was sufficient to arouse the action produced by the actual presentation of the stick; while the feeling of contrast between idea and object, and of the purposelessness of the act gave rise to unpleasurable emotions conflicting with the dog's habitual obedience.—WUNDT *Psychology*, lect. 24, p. 356. (Son. & Co., 1896.)

28. ACTION OF EXISTING CAUSES PROVED FOR THE PAST—*Lyell Transforms Geology.*—He completely refuted Cuvier's history of creation with its mythical revolutions, and established in its place the constant and slow transformation of the earth's crust by the continued action of forces, which are still working on the earth's surface, viz.: the movement of water and the volcanic fluid of the interior of earth. Lyell thus demonstrated a continuous and uninterrupted connection of the whole history of the earth, and he proved it so irrefutably, and established so convincingly the supremacy of the "existing causes," that is, of the causes which are still active in the transformation of the earth's crust, that geology in a short time completely renounced Cuvier's hypothesis.—HAECKEL *History of Creation*, vol. i, ch. 6, p. 132. (K. P. & Co., 1899.)

29. ACTION, RIGHT, TENDS TO RIGHT FEELING—*Forced Cheerfulness Will Conquer Depression.*—There is no more valuable precept in moral education than this, as all who have experience know: if we wish to conquer undesirable emotional tendencies in ourselves, we must assiduously, and in the first instance cold-bloodedly, go through the outward movements of those contrary dispositions which we prefer to cultivate. The reward of persistency will infallibly come, in the fading out of the sullenness or depression, and the advent of real cheerfulness and kindliness in their stead. Smooth the brow, brighten the eye, contract the dorsal rather than the ventral aspect of the frame, and speak in a major key, pass the genial compliment, and your heart must be frigid indeed if it do not gradually thaw! —JAMES *Psychology*, vol. ii, ch. 25, p. 463. (H. H. & Co., 1899.)

30. ACTIONS GOOD OR BAD IN THEMSELVES—*Harmony or Discord with Nature—Responsibility Dependent on Knowledge.*—Every act must have its own relation to the future. Every act must be either innocent, or beneficent, or hurtful in its ultimate tendencies and results. Or, if we like to put it in another form, every act must be according to the harmony of Nature or at variance with that harmony, and therefore an element of discord and disturbance. In all these senses, therefore, we speak, and we are right in speaking, of actions as in themselves good or bad, because we so speak of them according to our own knowledge of the relation in which they stand to those great axioms of morality, which are facts and not mere assumptions or even mere beliefs. But we are quite able to separate this judgment of the act from the judgment which can justly be applied to the individual agent. As regards him, the act is right or wrong, not according to our knowledge, but according to his own. And this great distinction is universally recognized in the language and (however unconsciously) in the thoughts of men. It is sanctioned, moreover, by supreme authority. The most solemn prayer ever uttered upon earth was a prayer for the forgiveness of an act of the most enormous wickedness, and the ground of the petition was specially declared to be that those who committed it "knew not what they did." —ARGYLL *Unity of Nature*, ch. 9, p. 198. (Burt.)

31. ACTIVITIES OF THE EARTH—*Like the Respiration and Movements of an Animal—Discovery of Causes a Part of Science.*—The internal heat of the earth, the elevation and depression of its crust, its belchings forth of vapors, ashes, and lava, are its activities, in as strict a sense, as are warmth and the movements and products of respiration the activities of an animal. The phenomena of the seasons, of the trade-winds, of the Gulf-stream, are as much the results of the reaction between these inner activities and outward forces, as are the building of the leaves in spring and their falling in autumn the effects of the interaction between the organization of a plant and the solar light and heat. And, as the study of the activities of the living being is called its physiology, so are these phenomena the subject-matter of an analogous telluric physiology, to which we sometimes give the name of meteorology, sometimes that of physical geography, sometimes that of geology. Again, the earth has a place in space and in time, and relations to other bodies in both these respects, which constitute its distribution. This subject is usually left to the astronomer; but a knowledge of its broad outlines seems to me to be an essential constituent of the stock of geological ideas. All that can be ascertained concerning the structure, succession of conditions, actions, and position in space of the earth, is the matter of fact of its natural history. But, as in biology, there remains the matter of reasoning from these facts to their causes, which is just as much science as the other, and indeed more.—HUXLEY *Lay Sermons*, serm. 11, p. 238. (G. P. P., 1899.)

32. ACTIVITIES UNDIFFERENTIATED IN ELEMENTARY ORGANISMS—*The*

Rhizopod or Ameba.—Where there are no distinctions of structure there are no distinctions of function. A rhizopod (*e. g.*, the ameba) will serve as an illustration. From the outside of this creature, which has not even a limiting membrane, there are protruded numerous processes. Originating from any point of the surface, each of these may contract again and disappear, or it may touch some fragment of nutriment which it draws with it, when contracting, into the general mass—thus serving as hand and mouth; or it may come in contact with its fellow-processes at a distance from the body and become confluent with them; or it may attach itself to an adjacent fixed object, and help by its contraction to draw the body into a new position. In brief, this speck of animated jelly is at once all stomach, all skin, all mouth, all limb, and doubtless, too, all lung.—SPENCER *Biology*, pt. ii, ch. 1, p. 200. (A., 1900.)

33. ACTIVITY OF MIND—*Increases Flow of Blood to Brain.*—The brain itself is an excessively vascular organ, a sponge full of blood, in fact; and [one] of Mosso's inventions showed that when less blood went to the arms, more went to the head. The subject to be observed lay on a delicately balanced table which could tip downward either at the head or at the foot if the weight of either end were increased. The moment emotional or intellectual activity began in the subject, down went the balance at the head-end, in consequence of the redistribution of blood in his system. But the best proof of the immediate afflux of blood to the brain during mental activity is due to Mosso's observations on three persons whose brain had been laid bare by lesion of the skull. By means of apparatus . . . this physiologist was enabled to let the brain-pulse record itself directly by a tracing. The intra-cranial blood-pressure rose immediately whenever the subject was spoken to, or when he began to think actively, as in solving a problem in mental arithmetic. Mosso gives in his work a large number of reproductions of tracings which show the instantaneity of the change of blood-supply, whenever the mental activity was quickened by any cause whatever, intellectual or emotional. He relates of his female subject that one day while tracing her brain-pulse he observed a sudden rise with no apparent outer or inner cause. She, however, confessed to him afterwards that at that moment she had caught sight of a skull on top of a piece of furniture in the room, and that this had given her a slight emotion.—JAMES *Psychology*, vol. i, ch. 3, p. 98. (H. H. & Co., 1899.)

34. ACTIVITY OF SOLAR FORCES—*Turmoil behind Beneficence—Productive Forces Not Always Beautiful in Operation.*—The furnace [the sun] whose fires maintain the life of the solar system is not merely aglow with intense light and heat, but is in a state of fierce turmoil. The most tremendous conflagrations ever witnessed upon our earth—great fires, by which whole cities have been destroyed—serve to suggest something of what is going on upon the sun, only that all the processes of such catastrophes must be supposed to be intensified a million-fold. As in great fires, there is a constant roar and tumult produced by the rush of air currents which the fire itself has generated, so in every part of the sun, on every square yard of that enormous surface, the most hideous uproar must prevail as fierce cyclonic storms, bred by solar fires, rush with inconceivable velocity over the flaming surface. In the most tremendous storms known upon earth the wind does not travel a hundred miles per hour, and the winds which rage amid the flames of a conflagration are of slow motion compared with true hurricanes; but the cyclonic storms which stir the fiery breath of the solar flames career often with the inconceivable velocity of more than a hundred miles in every second of time.—PROCTOR *Expanse of Heaven*, ch. 2, p. 17. (L. G. & Co., 1897.)

35. ACTIVITY OF SWALLOWS—*Usefulness as Insectivorous Birds.*—Swallows are eminently insectivorous. The tree-swallow is known to feed on bayberries when its usual fare is wanting, but, with this exception, it is doubtful if any but insect food passes a swallow's bill from one year's end to another. Recalling now the activity of swallows, which both necessitates a large supply of food and procures it, we must realize that these birds are incalculably beneficial.—CHAPMAN *Bird Life*, ch. 7, p. 212. (A., 1900.)

36. ACTIVITY, VOLCANIC, ON THE MOON—*Conflicting Testimony Explained.*—In the Sea of Nectar we see a small crater, of which the diameter measures about 6,000 meters (about 3¾ miles), rising isolated in the midst of a vast plain. Well, this crater is sometimes visible and sometimes invisible. From 1830 to 1837 it was certainly invisible, for two observers absolutely strangers to each other, Madler and Lohrmann, have minutely analyzed, described, and drawn this lunar country, and saw, very near the position it occupies, details of the ground very much less important than itself, without having the least suspicion [of it]. In 1842-43 Schmidt observed this same country without perceiving it. He saw it for the first time in 1851. It may be distinguished very well in a direct photograph by Rutherfurd taken in 1865. But in 1875 the English selenographer Neison examined, drew, and described this same place, with details the most minute and measures the most precise, without perceiving any trace of the volcano. Since then it has been seen again several times. It seems that the most simple explanation to give of these changes of visibility would be to admit that this volcano now and then emits smoke or vapors which remain for some time sus-

pended above it and hide it, as would happen to an aeronaut looking down from some height above Vesuvius at the epoch of its eruptions.—FLAMMARION *Popular Astronomy,* bk. ii, ch. 7, p. 152. (A.)

37. ACTOR PRACTISES ILLUSION ON AUDIENCE—*In Part upon Himself.*—Among all varieties of this deception [of self], that of the stage is the most complete. The actor is a man who has elaborately trained himself in the simulation of certain feelings. And when his acting is of the best quality, and the proper bodily attitude, gesture, tone of voice, and so on, are hit off, the force of the illusion completely masters us. For the moment we lose sight of the theatrical surroundings, and see the actor as really carried away by the passion which he so closely imitates. Histrionic illusion is as complete as any artistic variety can venture to be.—SULLY *Illusions,* ch. 9, p. 222. (A., 1897.)

38. ACTS, AUTOMATIC, ACCOMPLISHING A PURPOSE—*The Decapitated Frog—Organism Constituted to Secure Its Own Protection.*—It is well known that, if the hind-foot of a frog that has had its head cut off be pinched, it is withdrawn from the irritation. The stimulus to the afferent nerve reaches the gray matter of the spinal cord, and sets free a force which excites to action the corresponding motor nerves of the same side. When the foot is pinched more strongly, the force liberated by the stimulus passes across the cord to the motor nerves of the opposite side, and there is a simultaneous withdrawal of both limbs; and, if the excitation be stronger still, there is a wider irradiation of the effects of the stimulus in the gray matter, and a movement of all four limbs follows, the frog jumping away. These movements of the decapitated frog, which it is plain effect the definite purpose of getting it out of the way of harm, we believe to be analogous to the violent coughing by which food that has gone the wrong way is expelled from the human larynx, or to the vomiting by which offending matter is ejected from the stomach. Independently of consciousness and of will, an organism plainly has the power—call it intelligent or call it what we will—of feeling and eschewing what is hurtful to it, as well as of feeling and ensuing what is beneficial to it.—MAUDSLEY *Body and Mind,* lect. 1, p. 15. (A., 1898.)

39. ADAPTABILITY AMONG ANIMALS—*Horse and Ox Follow Man—Meet Man's Enemies in Every Clime.*—This spectacle [horses attacked by crocodiles] involuntarily reminds the contemplative observer of the adaptability granted by an all-provident nature to certain animals and plants. Like the farinaceous fruits of Ceres, the ox and horse have followed man over the whole surface of the earth—from the Ganges to the Rio de la Plata, and from the sea-coast of Africa to the mountainous plain of Antisana, which lies higher than the Peak of Teneriffe. In the one region the northern birch, in the other the date-palm, protects the wearied ox from the noonday sun. The same species of animal which contends in eastern Europe with bears and wolves is exposed, in a different latitude, to the attacks of tigers and crocodiles!—HUMBOLDT *Views of Nature,* p. 17. (Bell, 1896.)

40. ADAPTABILITY OF BIRDS—*Sparrows Utilize Electric Light.*—Some birds are influenced by changes in their surroundings, and alter their nesting habits when it proves to their advantage to do so. Chimney-swifts, who have exchanged hollow trees, in which they were exposed to their natural enemies, for the comparative safety of chimneys, are good examples. But a far better one is given by that prodigy in feathers, the house-sparrow. Is there any available site in which this thoroughly up-to-date bird will not place its nest? It has taken possession of even the hollow spaces about certain kinds of electric lamps, and has been observed repairing its nest at night by their light!—CHAPMAN *Bird Life,* ch. 5, p. 68. (A., 1900.)

41. ADAPTABILITY OF THE VERTEBRATE TYPE—*Laws of Nature the Expression of a Purpose.*—Among the many wonders of nature there is nothing more wonderful than this—the adaptability of the one vertebrate type to the infinite variety of life to which it serves as an organ and a home. Its basement has been so laid that every possible change or addition of superstructure could be built upon it. Creatures destined to live on the earth or in the earth, on the sea or in the sea, under every variety of condition of existence, have all been made after that one pattern; and each of them with as close an adaptation to special function as if the pattern had been designed for itself alone. It is true that there are particular parts of it which are of no use to particular animals. But there is no part of it which is not of indispensable use to some member of the group; and there is one supreme form in which all its elements receive their highest interpretation and fulfilment. It is indeed wonderful to think that the feeble and sprawling paddles on a newt, the ungainly flippers of a seal, and the long leathery wings of a bat, have all the same elements, bone for bone, with that human hand which is the supple instrument of man's contrivance, and is alive even to the finger-tips, with the power of expressing his intellect and his will. Here again the laws of nature are seen to be nothing but combinations of force with a view to purpose: combinations which indicate complete knowledge, not only of what is, but of what is to be, and which foresees the end from the beginning.—ARGYLL *Reign of Law,* ch. 4, p. 123. (Burt.)

42. ADAPTATION ADMITTED—*Design Denied—Appearance of Purpose Assumed*

to be without a Plan.—The struggle for life in natural selection acts with as much selective power as does the will of man in artificial selection. The latter, however, acts according to a plan and consciously, the former without a plan and unconsciously. This important difference between artificial and natural selection deserves especial consideration. For we learn by it to understand how arrangements serving a purpose can be produced by mechanical causes acting without an object, as well as by causes acting for an object. The products of natural selection are arranged even more for a purpose than the artificial products of man. and yet they owe their existence not to a creative power acting for a definite purpose, but to a mechanical relation acting unconsciously and without a plan.—HAECKEL *History of Creation*, vol. i, ch. 11, p. 284. (K. P. & Co., 1899.)

43. ADAPTATION CERTAINLY KNOWN—*The Only Question the Method of Its Production.*—And yet scientific men sometimes tell us that "we must be very cautious how we ascribe intention to nature. Things do fit into each other, no doubt, as if they were designed; but all we know about them is that these correspondences exist, and that they seem to be the result of physical laws of development and growth." Very likely: but how these correspondences have arisen, and are daily arising, is not the question, and it is immaterial how that question may be answered. Do those correspondences exist, or do they not? The perception of them by our mind is as much a fact as the sight or touch of the things in which they appear. They may have been produced by growth—they may have been the result of a process of development—but it is not the less the development of a mental purpose. It is the end subserved that we absolutely know. What alone is doubtful and obscure is precisely that which we are told is the only legitimate object of our research—viz.: the means by which that end has been attained.—ARGYLL *Reign of Law*, ch. 1, p. 20. (Burt.)

44. ADAPTATION, MUTUAL, OF DIVERSE ORGANISMS—*Dandelion Seed—Water-beetle.*—The structure of every organic being is related, in the most essential yet often hidden manner, to that of all the other organic beings with which it comes into competition for food or residence, or from which it has to escape, or on which it preys. This is obvious in the structure of the teeth and talons of the tiger; and in that of the legs and claws of the parasite which clings to the hair on the tiger's body. But in the beautifully plumed seed of the dandelion, and in the flattened and fringed legs of the water-beetle, the relation seems at first confined to the elements of air and water. Yet the advantage of the plumed seeds, no doubt, stands in the closest relation to the land being already thickly clothed with other plants, so that the seeds may be widely distributed and fall on unoccupied ground. In the water-beetle, the structure of its legs, so well adapted for diving, allows it to compete with other aquatic insects, to hunt for its own prey, and to escape serving as prey to other animals.—DARWIN *Origin of Species*, ch. 3, p. 71. (Burt.)

45. ADAPTATION OF COLOR TO ENVIRONMENT—*Black Cattle in Scotland—Trout Colored Like Bottom of Stream.*—The breeders of the polled Angus—a particular race of black cattle in Scotland—who make a great point of keeping up the perfect uniformity of their blackness, getting rid of every individual that has even a single white foot—take care to have everything black about their farmsteads; all the buildings are black, the horses are black, the dogs are black, the fowls are black. No breeder will have anything colored or white about his place. Tho no account can be given of the physiological action which makes these precautions effective (as they are asserted to be) in securing the desired result, yet I am strongly inclined to think that some influence of this kind is concerned in producing many singular correspondences between the surface-aspect of fishes and crustacea inhabiting shallow waters, and the characters of the bottoms on which they live. Every angler for trout is familiar with variations of this kind; and I have been assured of cases in which these fish, when transferred from one part of a stream to another, were found in no long time to have undergone a change in surface-markings, which gave them the same conformity to the new bottom as they previously had to the old.—CARPENTER *Nature and Man*, lect. 15, p. 443. (A., 1889.)

46. ——— ——— *Shades of Color Varied in Different Surroundings.*—To birds placed at so great a disadvantage, by a feeble flight and other adverse circumstances, in the race of life, bright colors would certainly prove fatal. It is true that brown is not in itself a protective color, and the clear, almost silky browns and bright chestnut tints in several species are certainly not protective: but these species are sufficiently protected in other ways, and can afford to be without a strictly adaptive color, so long as they are not conspicuous. In a majority of cases, however, the color is undoubtedly protective, the brown hue being of a shade that assimilates very closely to the surroundings. There are pale yellowish browns, lined and mottled, in species living amidst a sere, scanty vegetation: earthy browns, in those frequenting open sterile or stony places; while the species that creep on trees in forests are dark brown in color, and in many cases the feathers are mottled in such a manner as to make them curiously resemble the bark of a tree. The genera *lochmias* and *sclerurus* are the darkest, the plumage in these birds being nearly or quite

black, washed or tinged with rhubarb yellow. Their black plumage would render them conspicuous in the sunshine, but they pass their lives in dense tropical forests, where the sun at noon sheds only a gloomy twilight.—HUDSON *Naturalist in La Plata*, ch. 18, p. 248. (C. & H., 1895.)

47. ——— ——— *White Coloration of Arctic Animals Protective.*—In the arctic regions there are a number of animals which are wholly white all the year round, or which only turn white in winter. Among the former are the polar bear and the American polar hare, the snowy owl and the Greenland falcon; among the latter the arctic fox, the arctic hare, the ermine, and the ptarmigan. Those which are permanently white remain among the snow nearly all the year round, while those which change their color inhabit regions which are free from snow in summer. The obvious explanation of this style of coloration is that it is protective, serving to conceal the herbivorous species from their enemies, and enabling carnivorous animals to approach their prey unperceived.—WALLACE *Darwinism*, ch. 8, p. 130. (Hum., 1889.)

48. ADAPTATION OF COLOR TO HABITS—*Brilliancy of Color Possible for Female Birds in Protected Nests.*—There are considerable numbers of birds in which both sexes are similarly and brilliantly colored. Such are the extensive families of the kingfishers, the woodpeckers, the toucans, the parrots, the turacos, the hangnests, the starlings, and many other smaller groups, all the species of which are conspicuously or brilliantly colored, while in all of them the females are either colored exactly like the males, or, when differently colored, are equally conspicuous. . . . In all these cases, without exception, the species either nests in holes in the ground or in trees, or builds a domed or covered nest, so as completely to conceal the sitting-bird. We have here a case exactly parallel to that of the butterflies protected by distastefulness, whose females are either exactly like the males, or, if different, are equally conspicuous.—WALLACE *Darwinism*, ch. 10, p. 188. (Hum., 1889.)

49. ADAPTATION OF DEVICES TO CLIMATE—*Binding with Rawhide among the Eskimos.*—The peoples of the world who live north of the tree-line, and many who dwell in more temperate zones, have discovered the virtue of rawhide. The Eskimo spends many hours in cutting out miles of rawhide string, or babiche, of all degrees and sizes. This he uses in holding together not only the parts of his implements, but in manufactures of every kind. It is a marvelous substance. Frost that will snap steel nails like glass has no effect upon it. When it is put on green and allowed to dry, it shrinks nearly one-half, binding the parts immovably

Further south, as well as in the Arctic region, the tough sinew is taken from the leg of the deer. It is shredded as fine as silk, spun into yarn, and then twisted or braided into cord. This has no end of uses, not only in tool making, but in all arts where the greatest possible toughness and pliability are demanded. It serves to make a secure ferrule on the awl handle, to strengthen the bow, to hold feather and head on the arrow. It has an economic use for every day in the year.—MASON *Origins of Invention*, ch. 2, p. 41. (S., 1899.)

50. ADAPTATION OF FLOWERS TO INSECTS—*Contrivances That Guide or Force Visiting Insect to Fertilize Flower—The Labellum in Orchids.*—The labellum is by far the most important of the external envelopes of the flower. It not only secretes nectar, but is often modeled into variously shaped receptacles for holding this fluid, or is itself rendered attractive so as to be gnawed by insects. Unless the flowers were by some means rendered attractive, most of the species would be cursed with perpetual sterility. The labellum always stands in front of the rostellum, and its outer portion often serves as a landing-place for the necessary visitors. In *Epipactis palustris* this part is flexible and elastic, and apparently compels insects in retreating to brush against the rostellum. In *Cypripedium* the distal portion is folded over like the end of a slipper, and compels insects to crawl out of the flower by one of two special passages. In *Pterostylis* and a few other orchids the labellum is irritable, so that when touched it shuts the flower, leaving only a single passage by which an insect can escape. In *Spiranthes*, when the flower is fully mature, the column moves from the labellum, space being thus left for the introduction of the pollen-masses attached to the proboscis of a humblebee. In *Mormodes ignea* the labellum is perched on the summit of the column, and here insects alight and touch a sensitive point, causing the ejection of the pollen-masses. The labellum is often deeply channeled, or has guiding ridges, or is pressed closely against the column; and in a multitude of cases it approaches closely enough to render the flower tubular. By these several means insects are forced to brush against the rostellum.—DARWIN *Fertilization of Orchids*, ch. 9, p. 275. (A., 1898.)

51. ADAPTATION OF MEANS TO ENDS—*Seeming Intelligent Choice on the Part of Earthworms—Intelligence Not Limited by Size of Brain.*—To sum up, as chance does not determine the manner in which objects are drawn into the burrows, and as the existence of specialized instincts for each particular case cannot be admitted, the first and most natural supposition is that worms try all methods until they at last succeed; but many appearances are opposed to such a supposition. One alternative alone is left, namely, that worms, altho

standing low in the scale of organization, possess some degree of intelligence. This will strike every one as very improbable; but it may be doubted whether we know enough about the nervous system of the lower animals to justify our natural distrust of such a conclusion. With respect to the small size of the cerebral ganglia, we should remember what a mass of inherited knowledge, with some power of adapting means to an end, is crowded into the minute brain of a worker-ant.—DARWIN *Formation of Vegetable Mold,* ch. 2, p. 28. (Hum., 1887.)

52. ADAPTATION OF ORGANS TO MIND—*The Secret of Man's Supremacy.*—And when we remember that the immense variety of organic forms in the existing world does not exhaust the adaptability of their plan, but that the still vaster varieties of all the extinct creations have circled round the same central types, it becomes evident that these types have had from the first a purpose which has been well and wonderfully fulfilled. As a matter of fact, we see that the original conception of the framework of organic life has included in itself provisions for applying the principle of adaptation in infinite degrees. Its last development is in man. . . . There are stronger arms, there are swifter limbs, there are more powerful teeth, there are finer ears, there are sharper eyes. There are creatures which go where he cannot go, and can live where he would die. But all his members are coordinated with one power—the power of thought. Through this he has the dominion over all other created things—whilst yet as regards the type and pattern of his frame he has not a single bone or joint or organ which he does not share with some one or other of the beasts that perish. It is not in any of the parts of his structure, but in their combination and adjustment, that he stands alone.—ARGYLL *Reign of Law,* ch. 4, p. 120. (Burt.)

53. ADAPTATION OF PARALYTIC TO NEW CONDITION—*Increase of Muscular Force for Same Movement—Effect of Practise.*—A patient who is partly paralyzed in leg or arm, so that he can only move the limb with very great effort, has a distinct sensation of this effort: the limb seems heavier than it used to be, as tho weighted with lead; that is to say, there is a sensation of greater expenditure of force than before, altho the work actually done is the same or even less. For the performance of this amount of work there is required an innervation of abnormal intensity. In the same way, the patient will deceive himself, especially in the first stages of the disease, with regard to the extent of his movements. His steps are short and uncertain; his hand misses the objects which he is reaching for. By degrees, if his condition remains unchanged for a long time, he regains more or less precision of movement; practise gives him familiarity with his new system of muscle-sensations.—WUNDT *Psychology,* lect. 9, p. 136. (Son. & Co., 1896.)

54. ADAPTATION OF PLANT TO ANIMAL FOOD—*Secretion Poured Out When Object To Be Digested.*—It is a much more remarkable fact that when an object, such as a bit of meat or an insect, is placed on the disk of a leaf, as soon as the surrounding tentacles become considerably inflected, their glands pour forth an increased amount of secretion. I ascertained this by selecting leaves with equal-sized drops on the two sides, and by placing bits of meat on one side of the disk; and as soon as the tentacles on this side became much inflected, but before the glands touched the meat, the drops of secretion became larger. This was repeatedly observed, but a record was kept of only thirteen cases, in nine of which increased secretion was plainly observed; the four failures being due either to the leaves being rather torpid, or to the bits of meat being too small to cause much inflection. We must therefore conclude that the central glands, when strongly excited, transmit some influence to the glands of the circumferential tentacles, causing them to secrete more copiously.—DARWIN *Insectivorous Plants,* ch. 1, p. 11. (A., 1900.)

55. ADAPTATION, PRIMITIVE, OF HANDLES TO TOOLS—In almost every section of North America occurs the "grooved ax," and there grow a great many varieties of wood, like ash or hickory, whose saplings will bend double without breaking and will easily split. The Indians were accustomed to take a piece of one of these saplings about six feet long and split it, so that, in bending about the groove of the ax or adz or hammer, it would neatly fit. The hafting was completed by securely seizing the sides together near the working piece and at the grip. . . . This style might have been seen in the United States anywhere between the two oceans.—MASON *Origins of Invention,* ch. 2, p. 37. (S., 1899.)

56. ADAPTATION TO ENVIRONMENT BY ANIMALS—*Deep-sea Organisms with Movable Plates Adjustable to Pressure.*—In shallow-water sea-urchins the shells are composed of a great number of little plates that fit so closely to one another that no movement is possible between them. When the animal dies all the soft tissues decay and the shell remains, to be tossed about by the waves until crunched or dashed to pieces. In *Phormosoma,* however, the tiny plates of which the shell is composed are freely movable on one another, and when the animal is alive very considerable contractions and expansions can take place. None of the modern shallow-water echinoids present this peculiarity, and it is a very interesting and surprising fact that in this respect the fossils of the chalk should re-

semble so closely the living urchins of the abyss.—HICKSON *Fauna of the Deep Sea,* ch. 5, p. 102. (A., 1894.)

57. ——— ——— *Dogs Change during Growth—Heredity of Acquired Characters.*—The influence of physical conditions in modifying the constitution is well known to be most strongly exerted during the earlier period of life; for as long as the organism is in process of development it will grow to its environment, as it will not do at a later epoch, when it will either resist or succumb. We are told by Sir Charles Lyell that the Cornish miners, who went out some sixty years ago to work the Real del Monte mines in Mexico, took out some greyhounds to hunt the hares which abound on the elevated plateaux of that country; but that, in consequence of the rarefied condition of the air, the dogs could not continue the chase, but lay down panting for breath. The offspring of those dogs, however, brought up at this elevation, were able to run down the hares as well as if both had been on a lower level. The constitution of the young dogs adapted itself to the environment in which they grew up; but whence that adaptability? We do not find it in any but living organisms; no physical property gives the least account of it.—CARPENTER *Nature and Man,* lect. 15, p. 440. (A., 1889.)

58. ——— ——— *Kangaroo Must Traverse Desert Swiftly, while Its Forefeet Serve as Hands.*—Some of them [kangaroos] are very large animals, as bulky as deer, and rapidity of locomotion is especially necessary for a large animal which inhabits a country subject to such severe and widely extended droughts as is Australia. . . . In the kangaroos we have animals which require to use their front limbs for purposes of more or less delicate manipulation, with respect to the economy of the "pouch." Accordingly, for such creatures to be able to inhabit such a country, the hind limbs must by themselves answer the purpose of both the front and hind limbs of deer and antelopes. But the kangaroo's limbs are quite admirably suited to its needs. The front pair serve as prehensile manipulating organs, while the hind pair amply suffice to carry the animal over great distances and rapidly traverse wide, arid plains in pursuit of rare and distant water. —MIVART *Types of Animal Life,* ch. 2, p. 48. (L. B. & Co., 1893.)

59. ——— ——— *Lizards That Live without Water.*—The individuals [lizards of the terrestrial species of *Amblyrhyncus,* of the Galapagos Islands], and they are the greater number, which inhabit the lower country, can scarcely taste a drop of water throughout the year; but they consume much of the succulent cactus, the branches of which are occasionally broken off by the wind. I several times threw a piece to two or three of them when together; and it was amusing enough to see them trying to seize and carry it away in their mouths, like so many hungry dogs with a bone.—DARWIN *Naturalist's Voyage Around the World,* ch. 17, p. 389. (A., 1893.)

60. ——— ——— *The Sloth, as Known to Recent Science.*—Far from being an "imperfect sketch" of animal life, it [the sloth] is a fully completed study of perfect adaptation of structure to need. The sloth is an animal specially formed to dwell nowhere but in luxuriant forests. But to live thus . . . necessitates a special and peculiar structure. . . . It is impossible that an animal formed to do this can at the same time be organized so as to move well and freely on the surface of the ground, for which the stress and leverage must be altogether different. Hence the structure of such a creature must seem very defective to any one who only observes its motions on the surface of the soil, a position in which it naturally hardly if ever finds itself. . . . Sloths pass their lives hanging under the branches of trees, back downwards, and so they can sleep securely. The fingers and toes of each hand and foot are so closely bound together that they cannot be separated; while each finger and toe is furnished with an enormously long and very strong nail, greatly curved. When at rest the hands and feet are so bent that each thus forms a strong hook, and it requires an effort on the part of the animal to unhook either a hand or foot from the branch it clasps. Thus it is that the sloth can sleep suspended from a branch, and remain so after death.—MIVART *Types of Animal Life,* ch. 9, p. 249. (L. B. & Co., 1893.)

61. ——— ——— *Vast Size of Whale Possible Only for Marine Animal.*—There results a limitation of growth in a land-animal, which does not exist for an animal living in the water. If, after observing the swaying flesh of an elephant as it walks along, we consider what would happen could there be formed a land-animal equal in mass to the whale, it needs no argument to show that such a creature could not stand, much less move about. But in the water the strain put upon its structures by the weights of its various parts is almost if not quite taken away.—SPENCER *Biology,* pt. ii. ch. 1, p. 156. (A., 1900.)

62. ADAPTATION TO ENVIRONMENT BY MEN—*Arboreal Human Life—Former South American Tree-dwellers.*—This region [South American steppes], which may be regarded as peculiarly the habitation of wild animals, would not have been chosen as a place of settlement by nomadic hordes, who prefer a vegetable diet, had it not possessed some few fan-palms *(Mauritia)* scattered here and there. The beneficent qualities of this tree of life have been universally celebrated. Upon this alone subsist

the unsubdued tribe of the Guaranes, at the mouth of the Orinoco northward of the Sierra de Imataca. When they increased in numbers and became overcrowded, it is said that, besides the huts which they built on horizontal platforms supported by the stumps of felled palm-trees, they also ingeniously suspended from stem to stem spreading mats or hammocks woven of the leaf-stalk of the Mauritia, which enabled them, during the rainy season, when the Delta was overflowed, to live in trees in the manner of apes. These pendent huts were partly covered with clay. The women kindled the fire necessary for their culinary occupations on the humid flooring. As the traveler passed by night along the river, his attention was attracted by a long line of flame suspended high in the air, and apparently unconnected with the earth. The Guaranes owe the preservation of their physical, and perhaps even of their moral independence, to the loose marshy soil, over which they move with fleet and buoyant foot, and to their lofty sylvan domiciles; a sanctuary whither religious enthusiasm would hardly lead an American stylite.—HUMBOLDT *Views of Nature*, p. 12. (Bell. 1896.)

63. ADAPTATION TO LIFE-WORK—*Teeth of Beaver Self-sharpening.*—The amazing facility the beaver possesses for felling trees is due to the power of its jaws and teeth. Of these there are, as in the aye-aye, two large cutting teeth above and two below, separated by a toothless interspace from the grinding teeth behind them. Each cutting tooth is protected in front by a coating of very dense enamel, so that at its summit it wears away less quickly in front than behind, and thus a sharp, chisel-like cutting edge is constantly preserved.—MIVART *Types of Animal Life*, ch. 12, p. 352. (L. B. & Co., 1893.)

64. ADAPTATION TO SEASON—*Grouse Provided with Snowshoes in Winter.*—By far the best instance of modification in the structure of the feet is furnished by grouse. It is an unusual case of seasonal adaptation in form. During the summer the toes of grouse are bare and slender, but as these birds are largely ground-haunters, and most of them inhabit regions where the snowfall is heavy, the toes in winter acquire a comblike fringe on either side. Practically, therefore, grouse don snowshoes in the fall, and wear them until the following spring.—CHAPMAN *Bird-Life*, ch. 2, p. 27. (A., 1900.)

65. ADAPTATION TO TWO ELEMENTS AT ONCE—*Fish with Divided Eye.*—Mr. Agassiz was especially interested in seeing alive for the first time the curious fish called "tralhote" by the Indians, and known to naturalists as the *Anableps tetrophthalmus.* This name, signifying "four-eyed," is derived from the singular structure of the eye. A membranous fold enclosing the bulb of the eye stretches across the pupil, dividing the visual apparatus into an upper and lower half. No doubt this formation is intended to suit the peculiar habits of the Anableps. These fishes gather in shoals on the surface of the water, their heads resting partly above, partly below the surface, and they move by a leaping motion somewhat like that of frogs on land. Thus, half in air, half in water, they require eyes adapted for seeing in both elements, and the arrangement described above just meets this want.—AGASSIZ *Journey in Brazil*, ch. 4, p. 143. (H. M. & Co., 1896.)

66. ADAPTATION TO USE THROUGHOUT NATURE—*Darwinism Involves a New Teleology.*—Adaptation to use, altho the very essence of Darwinism, is not a fixed and inflexible adaptation, realized once for all at the outset; it includes a long progression and succession of modifications, adjusting themselves to changing circumstances, under which they may be more and more diversified, specialized, and in a just sense perfected. Now, the question is, does this involve the destruction or only the reconstruction of our consecrated ideas of teleology? Is it compatible with our seemingly inborn conception of nature as an ordered system? Furthermore, and above all, can the Darwinian theory itself dispense with the idea of purpose, in the ordinary sense of the word, as tantamount to design.—ASA GRAY *Darwiniana*, art. 13, p. 358. (A., 1889.)

67. ADAPTATIONS IN BIRD-STRUCTURE CUMULATIVE—*All Converged on the Power of Flight—Not Less Designed Because a Growth.*—Now if, in examining the structure of a typical bird, we find evidences of "design" in the wonderful adaptation of its clothing of feathers alike to keep in the warmth of the body, and to sustain it in its flight through the air—in that organization of its heart and lungs which enables them to keep up the energetic circulation and respiration required for the maintenance of a high standard of muscular activity—in those arrangements of the skeleton and muscular apparatus which give support and motion to the expanded wings—in the adaptation of the eye to that acute and far-ranging vision which is needed for the guidance of its actions—and in many other provisions I might enumerate—I affirm, without any doubt of your assent, that this evidence is not in the least degree invalidated by the discovery that the germ-particle is not a miniature bird, but a protoplasmic "jelly-speck." In its capacity for "evolution" into the complete type, the germ-particle is just as much "potentially" the bird as if it could become one by merely swelling out.—CARPENTER *Nature and Man*, lect. 15, p. 432. (A., 1889.)

68. ADAPTATIONS MANIFOLD IN NATURE—*One Part Serves Many Purposes.*—Altho an organ may not have been originally

formed for some special purpose, if it now serves for this end we are justified in saying that it is specially adapted for it. On the same principle, if a man were to make a machine for some special purpose, but were to use old wheels, springs, and pulleys, only slightly altered, the whole machine, with all its parts, might be said to be specially contrived for its present purpose. Thus throughout nature almost every part of each living being has probably served, in a slightly modified condition, for diverse purposes, and has acted in the living machinery of many ancient and distinct specific forms.—DARWIN *Fertilization of Orchids*, ch. 9, p. 283. (A., 1898.)

69. ADAPTIVENESS OF HUMAN ORGANISM—*Acquired Automatism—Houdin's Play with Balls.*—The extraordinary adaptiveness of the organism of man is shown in his power of acquiring a vast number of more special actions, which have no direct relation to his bodily wants, but minister to requirements of his own creation. These often become, by a process of prolonged "training," not less automatic than the act of walking; as is shown by the fact that, when once set going, they will continue in regular sequence, not only without any volitional exertion, but whilst the attention is wholly directed elsewhere. . . . With a view of cultivating the rapidity of visual and tactile perception, and the precision of respondent movements, which are necessary for success in every kind of "prestidigitation," Houdin early practised the art of juggling with balls in the air; and having, after a month's practice, become thorough master of the art of keeping up four balls at once, he placed a book before him, and, while the balls were in the air, accustomed himself to read without hesitation.—CARPENTER *Mental Physiology*, ch. 5, p. 217. (A., 1900.)

70. ADAPTIVENESS OF NATURE—*Wings for Other Use than Flight—Penguin—"Steamer"—Ostrich.*—In these [Falkland] islands a great loggerheaded duck or goose . . . is very abundant. . . . They are named, appropriately, steamers. Their wings are too small and weak to allow of flight, but by their aid, partly swimming and partly flapping the surface of the water, they move very quickly. These clumsy, loggerheaded ducks make such a noise and splashing that the effect is exceedingly curious. Thus we find in South America three birds which use their wings for other purposes besides flight: the penguin as fins, the steamer as paddles, and the ostrich as sails; and the apteryx of New Zealand, as well as its gigantic extinct prototype the deinornis, possess only rudimentary representatives of wings.—DARWIN *Naturalist's Voyage Around the World*, ch. 9, p. 200. (A., 1898.)

71. ADJUSTMENT OF AERIAL TEMPERATURE—*Dead-line of Cold Just Overhangs Zone of Life—Earth's Heat Not Greatly Changed through Geologic Ages.*—It is not easy to appreciate the delicacy of adjustment which is required to establish this temperature demanded by organic life, and to maintain it through the geological ages. Even in the permanent heat of the equator the zone of life-killing cold lies but four miles above the surface of the sea. As soon as night comes on, this dead-line begins to descend toward the surface; by morning it may have fallen to within three miles of the sea-level. A week of continued night would lock the tropics in a deadly frost and make an end of its land-life.—SHALER *Aspects of the Earth*, p. 201. (S., 1900.)

72. ADJUSTMENT OF CHEMICAL AFFINITIES IN THE BODY—*Life Supreme.*—There is indeed an adjustment—a close and intricate adjustment—between the chemical affinities of these elements as they are combined in the living body; but it is an adjustment of them under the controlling energy of a power which cannot be identified with any other, and which always presents phenomena peculiar to itself. Under that power we see that the laws and forces of chemical affinity, as exhibited apart from life, are held, as it were, to service—compelled, indeed, to minister, but not allowed to rule. Through an infinite variety of organisms this mysterious subordination is maintained, ministering through an ascending series to higher and higher grades of sensation, perception, consciousness, and thought.—ARGYLL *Unity of Nature*, ch. 2, p. 34. (Burt.)

73. ADJUSTMENT OF MENTAL FORCES—*Conduct Determined by Combination of Motives.*—It is true, indeed, that there are in the mind of man, as there are in nature, certain forces originally implanted which are unchangeable in this sense, that they have an invariable tendency to determine conduct in a particular direction. But as in nature we have a power of commanding her elementary forces by the methods of adjustment, so in the realm of mind we can operate on the same principle, by setting one motive to counteract another: and by combination among many motives we can influence in a degree, and to an extent as yet unknown, the conduct and the condition of mankind.—ARGYLL *Reign of Law*, ch. 7, p. 219. (Burt.)

74. ADJUSTMENT OF ORGANISM TO ENVIRONMENT—*Wing-feathers and Auriculars in Birds—Internal vs. External Correlation.*—There are two correlations of growth in respect to feathers which are constant. In all cases (excepting, of course, the wingless birds) the feathers which grow from the forearm and finger-bones, constituting the wings, are comparatively long, strong, tapering, elastic, and with thin lateral filaments, which filaments are closely hooked together by means of minute

teeth fitting into each other, so that the whole shall form one continuous surface or web. This is a correlation of growth between one particular kind of feather and one particular member of the body, which, in all birds capable of flight, is constant, and amounts to a universal law. Now let us contrast this with another correlation of growth which is equally constant. On the side of the head of all birds there is a patch of feathers of peculiar structure, with fine and slender shafts, and with the lateral filaments not hooked together as in the other case, but, on the contrary, always separated from each other—the whole series forming a fine and open network spread over the surface which they cover and protect. These feathers cover the orifice of the ear, and are called the auriculars. They are correlated with the curious passages, the finely hung clapper-bones, and all the elaborate mechanism of that organ. Such are the internal correlations. But they are intelligible only when considered in the light shed by other correlations which are external. The wing-feathers, with close continuous webs, are correlated to the laws by which the passage of air may be prevented; the auricular feathers, with open unconnected webs, are correlated to the laws by which the passage of sound may be rendered easy. The one set of feathers is adapted to the active function of evoking and resisting atmospheric pressure by striking strong, yet light and elastic blows, upon the air; the other set of feathers is adapted to the passive function of allowing the free access of the waves of sound into the passages of the ear. These are but a few examples out of millions. Throughout the whole range of nature the system of internal correlation is entirely subordinate to the system of external correlation.—ARGYLL *Reign of Law*, ch. 5, p. 151. (Burt.)

75. ADJUSTMENT OF ORGANS FOR MUSICAL EFFECT—*A Natural Violin—The Mole-cricket.*—If one walks in the meadows along a little brook on a fine June evening, he will often hear a long-sustained note, even, subdued, and pleasant, which vibrates powerfully without swelling or diminishing, somewhat like that of the nightingale in Haydn's "Toy Symphony." A cautious approach will enable us to see a mole-cricket sitting, apparently motionless, in front of its hole in the ground. More careful examination proves that the short wing-covers are in a state of continual vibration, producing friction as they move; and this it is which causes the sound. The microscope shows that minute and delicate teeth are placed at regular intervals along a vein on one of the wing-covers; when these are struck at a certain rate by a vein on the other wing, they emit a whirring note of a definite pitch. One vein acts as the bow, the other as the string of a violin; the mole-cricket is a violinist, and can therefore hold on its note as long as it will.—WEISSMAN *Heredity*, vol. ii, p. 34. (Cl. P., 1892.)

76. ADJUSTMENT OF SOUL TO THE NON-EXISTENT—*A Breach of Continuity—Would Violate All Analogy of Nature.*—Now if the relation thus established in the morning twilight of man's existence between the human soul and a world invisible and immaterial is a relation of which only the subjective term is real and the objective term is non-existent, then, I say, it is something utterly without precedent in the whole history of creation. All the analogies of evolution, so far as we have yet been able to decipher it, are overwhelmingly against any such supposition. To suppose that during countless ages, from the sea-weed up to man, the progress of life was achieved through adjustments to external realities, but that then the method was all at once changed and throughout a vast province of evolution the end was secured through adjustments to external non-realities, is to do sheer violence to logic and to common sense.—FISKE *Through Nature to God*, pt. iii, ch. 10, p. 189. (H. M. & Co., 1900.)

77. ADJUSTMENT OF VISION TO DISTANCE—*Adaptation Automatic and Unconscious.*—Mark, now, the superiority of the eye. In its normal condition this wonderful organ possesses a power to which no optical instrument of human construction can show the remotest parallelism—that of adjusting itself to differences of focal distance. Thus, if I close one eye, and hold up my finger between my other eye and the clock at the far end of the room, I cannot see both of them distinctly at the same time, because, as they are at different distances from my eye, their pictures on my retina cannot both be distinct. But, without moving either my head or my eye, I can so "focus" my eye on either as to see it distinctly, the other becoming hazy. This we all constantly do without the least knowledge of the mechanism by which it is effected: and all that the most careful and refined investigation has revealed to the physiologist is that the focal adjustment is made by a change in the curvature of the crystalline lens; its curvature being increased when the rays that fall upon it are more divergent, because proceeding from a nearer object; and being diminished when the rays, proceeding from a more distant object, are less divergent—so as in each case to bring them to a focus on the retina. This change of curvature is produced, it is believed, by the action of the ciliary muscle which surrounds the lens; but how that action is called forth we do not know. Indeed, we are quite unconscious that we are putting it into contraction. I simply determine, "I will look at the clock," or, "I will look at my finger," and my eye adjusts itself accordingly. If, on the other hand, I were to look with a telescope, first at a watch-face a few feet off, and then at a

church-clock at a distance, I should have to diminish the distance between the object-glass and the eye-piece; and I cannot conceive of any optical mechanism by which the telescope could be enabled to make this adjustment for itself. That the eye should be provided with such a mechanism has always seemed to me a most wonderful evidence of intelligent design; and the importance of this provision in our daily life is so great (as every one knows in whom it is even partially deficient) as to outweigh beyond all comparison the slight want of optical perfection which . . . is inseparable from it.—CARPENTER *Nature and Man*, lect. 15, p. 425.

78. ADVANCE ALONG ABORIGINAL LINES—*Improvement in Mechanic Arts—Perfected Snow-shoes.*—The Canadian Indians and those of the northern United States, having only soft material and bark to work upon, restrict themselves mostly to the long-bladed curved knife. On the Pacific coast, among Indian tribes from Mount St. Elias and southward, there is a mixture of hard material and soft wood, so that there is a great variety in the form of the whittler's knife. Furthermore, these tribes have been in contact with sailors for more than a century, and use any piece of steel or iron they can secure in trade. The Canadian Indians were stimulated by the fur-trading companies to travel more rapidly and to make longer journeys; hence, in furnishing them with the curved knife, they made it possible for these Indians to work out the frame of the birch-bark canoe, the bows of the snow-shoes, splints for basketry, and a thousand and one objects made of birch-bark, with this simple but most efficient device. It has become the traveling tool of the Canadian Indians and has done more than aught else to improve their mechanical skill. An examination of old patterns of snow-shoes, in comparison with the latest patterns, reveals an astonishing improvement. The versatile curved knife is just as useful in the making of fine babiche or rawhide string for the webbing of the snow-shoe as in whittling down the frame. In the old-fashioned snow-shoes the rawhide footing is nearly one-fourth inch wide, while in the best and latest the strands are as fine as thread.—MASON *The Man's Knife Among the North American Indians, (Report of the U. S. National Museum)*, p. 732.

79. ADVANCE FROM KNOWN TO UNKNOWN—*Acquaintance with Phenomena of Sound-waves Led to Discovery of Waves of Light—Young Demonstrates the Undulatory Theory.*—In the year 1773 was born, at Milverton, in Somersetshire, one of the most remarkable men that England ever produced. He [Thomas Young] was educated for the profession of a physician, but was too strong to be tied down to professional routine. He devoted himself to the study of natural philosophy, and became in all its departments a master. He was also a master of letters. Languages, ancient and modern, were housed within his brain, and, to use the words of his epitaph, "he first penetrated the obscurity which had veiled for ages the hieroglyphics of Egypt." It fell to the lot of this man to discover facts in optics which Newton's theory was incompetent to explain, and his mind roamed in search of a sufficient theory. He had made himself acquainted with all the phenomena of wave-motion; with all the phenomena of sound; working successfully in this domain as an original discoverer. Thus informed and disciplined, he was prepared to detect any resemblance which might reveal itself between the phenomena of light and those of wave-motion. Such resemblances he did detect; and, spurred on by the discovery, he pursued his speculations and his experiments until he finally succeeded in placing on an immovable basis the undulatory theory of light.—TYNDALL *Lectures on Light*, lect. 2, p. 50. (A., 1898.)

80. ADVANCE IN OUR KNOWLEDGE OF LIVING ORGANISMS—*Inadequate Early Estimates.*—The species known to the naturalists of early times were few in number—at least, comparatively—and the old students had no idea of the excessive diversity of form and structure familiar to us. A census of animals and plants was taken by Ray [1670-93] shortly before Linnæus commenced his career, and enumerated less than 4,000 animals, exclusive of insects; and of those it was estimated that there were about "20,000 in the whole world." He evidently believed that the entire number living would not be found greatly to exceed this. But let Ray speak for himself. According to the author's classification, animals were divided into four orders—"beasts, birds, fishes, and insects." The number of beasts, including also serpents, that had been accurately described, he estimated at not above 150, adding that, according to his belief, "not many that are of any considerable bigness, in the known regions of the world, have escaped the cognizance of the curious." (At the present day more than 7,000 species of "beasts," reptiles, and amphibians have been described.) The number of birds "may be near 500; and the number of fishes, excluding shell-fish, as many; but, if the shell-fish be taken in, more than six times the number." As to the species remaining undiscovered, he supposed "the whole sum of beasts and birds to exceed by a third part, and fishes by one-half, those known." The number of insects—that is, of animals not included in the above classes—he estimated at 2,000 in Britain alone, and 20,000 in the whole world. . . . About 375,000 species of animals are now known, and of insects we still know the smaller portion. . . . The late Dr. C. V. Riley even went so far as to say "that there are 10,000,000 species of

insects in the world would be, in [his] judgment, a moderate estimate." The largest previous estimate, by Sharp and Walsingham, 2,000,000, was termed by Riley "extremely low."—GILL *Address before the Am. Assoc. for the Advancement of Science, Smithsonian Report for 1896*, pp. 457-483.

81. ADVANCE IN SCIENCE—*The Joy of Its Study Alike in All Ages.*—Each of these epochs of the contemplation of the external world—the earliest dawn of thought and the advanced stage of civilization—has its own source of enjoyment. In the former, this enjoyment, in accordance with the simplicity of the primitive ages, flowed from an intuitive feeling of the order that was proclaimed by the invariable and successive reappearance of the heavenly bodies, and by the progressive development of organized beings; while in the latter, this sense of enjoyment springs from a definite knowledge of the phenomena of nature. When man began to interrogate nature, and, not content with observing, learned to evoke phenomena under definite conditions; when once he sought to collect and record facts, in order that the fruit of his labors might aid investigation after his own brief existence had passed away, the philosophy of nature cast aside the vague and poetic garb in which she had been enveloped from her origin, and, having assumed a severer aspect, she now weighs the value of observations, and substitutes induction and reasoning for conjecture and assumption.—HUMBOLDT *Cosmos*, vol. i, int., p. 24. (H., 1897.)

82. ADVANCE IN TYPE—*None Since the Mammalia Were Reached—The Mothers Stand Now at the Top.*—What was that pinnacle? There is no more instructive question in science. For the answer brings into relief one of the expression-points of nature—one of these great teleological notes of which the natural order is so full, and of which this is by far the most impressive. Run the eye for a moment up the scale of animal life. At the bottom are the first animals, the Protozoa. The Cœlenterata follow, then in mixed array the Echinoderms, Worms, and Mollusks. Above these come the Pisces, then the Amphibia, then the Reptilia, then the Aves, then—what? The Mammalia, THE MOTHERS. There the series stops. Nature has never made anything since.—DRUMMOND *Ascent of Man*, p. 267. (J. P., 1900.)

83. ADVANCE OF CIVILIZATION—*Epoch-making Ideas.*—Those are happy hours to most of us when we recall the days of childhood. To trace the lives of celebrated men and women to the springs of their moral and intellectual power brings never-fading delight. To study the rise and progress of a nation or any social unit is worthy of exalted minds. But the most profitable inquiry of all is the search for the origin of epoch-making ideas in order to comprehend the history of civilization, to conjure up those race memories in which each people transmits to itself and to posterity its former experiences.—MASON *The Birth of Invention (Address at Centenary of American Patent System, Washington, 1891*, proceedings), p. 403.

84. ADVANCE OF GLACIERS IN RECENT TIMES—*Road Buried under Ice.*—We have ample traditional evidence of the oscillations of glacier-boundaries in recent times. During the religious wars of the sixteenth century, when the Catholics gained the ascendency in the Canton of Valais, the inhabitants of the upper valleys adhered to the Protestant faith. Shut out from ordinary communication with the Protestant churches by the Bernese Oberland, the account states that these peasants braved every obstacle to the exercise of their religion, and used to carry their children over a certain road by the valley of Viesch, across the Alps, to be baptized at Grindelwald, on the farther side of the glaciers of Aletsch and Viesch. I could not understand this statement, for no such road exists, or could be conceived possible at present; nor was there any knowledge of it among the guides, intimate as they are with every feature of the region. Impressed, however, with the idea that there must be some foundation for the statement, I carefully examined the ground, and, penetrating under the glacier of Aletsch, I actually found, a number of feet below the present level of the ice, the paved road along which these hardy people traveled to church with their children, and some traces of which are still visible. It has been almost completely buried, altho here and there it reappears; but at this day it is completely impassable for ordinary travel.—AGASSIZ *Geological Sketches*, ser. ii, p. 10. (H. M. & Co., 1896.)

85. ADVANCE OF INTELLECT PREPARES FOR NEW DISCOVERY—*A Great Period Sustains Great Men.*—All great discoveries are duly prepared for in two ways: first, by other discoveries which form their prelude; and, secondly, by the sharpening of the inquiring intellect. Thus Ptolemy grew out of Hipparchus, Copernicus out of both, Kepler out of all three, and Newton out of all the four. Newton did not rise suddenly from the sea-level of the intellect to his amazing elevation. At the time that he appeared, the table-land of knowledge was already high. He juts, it is true, above the table-land, as a massive peak; still he is supported by it, and a great part of his absolute height is the height of humanity in his time. It is thus with the discoveries of Kirchhoff. Much had been previously accomplished; this he mastered, and then by the force of individual genius went beyond it. He replaced uncertainty by certainty, vagueness by definiteness, confusion by or-

der; and I do not think that Newton has a surer claim to the discoveries that have made his name immortal than Kirchhoff has to the credit of gathering up the fragmentary knowledge of his time, of vastly extending it, and of infusing into it the life of great principles.—TYNDALL *Lectures on Light*, lect. 6, p. 206. (A., 1898.)

86. ADVANCE OF LEARNING IN SEVENTEENTH CENTURY—*A Galaxy of Discoveries.*—A few names will suffice to give an idea of the gigantic strides with which the human mind advanced in the seventeenth century, especially in the development of mathematical induction, under the influence of its own subjective force rather than from the incitement of outward circumstances. The laws which control the fall of bodies and the motions of the planets were now recognized. The pressure of the atmosphere; the propagation of light, and its refraction and polarization, were investigated. Mathematical physics were created, and based on a firm foundation. The invention of the infinitesimal calculus characterizes the close of the century; and, strengthened by its aid, human understanding has been enabled, during the succeeding century and a half, successfully to venture on the solution of the problems presented by the perturbations of the heavenly bodies; by the polarization and interference of the waves of light; by the radiation of heat; by electro-magnetic reentering currents; by vibrating chords and surfaces; by the capillary attraction of narrow tubes; and by many other natural phenomena. Henceforward the work in the world of thought progresses uninterruptedly, each portion continually contributing its aid to the remainder.—HUMBOLDT *Cosmos*, vol. ii, pt. ii, p. 302. (H., 1897.)

87. ADVANCE OF PHOTOGRAPHY—*Stars Revealed That Are Invisible Even through the Telescope.*—Celestial photography is not yet fifty years old; yet its earliest beginnings already seem centuries behind its present performances. . . . The chemical plate has two advantages over the human retina. First, it is sensitive to rays which are utterly powerless to produce any visual effect; next, it can accumulate impressions almost indefinitely, while from the retina they fade after one-tenth part of a second, leaving it a continually renewed *tabula rasa*. It is accordingly quite possible to photograph objects so faint as to be altogether beyond the power of any telescope to reveal; and we may thus eventually learn whether a blank space in the sky truly represents the end of the stellar universe in that direction, or whether farther and farther worlds roll and shine beyond, veiled in the obscurity of immeasurable distance.—CLERKE *History of Astronomy*, pt. ii, ch. 13, p. 524. (Bl., 1893.)

88. ADVANCE OF PRIMITIVE MAN—*From the Stone Age to a Better Stone Age—The Smoothed and Sharpened Tool Slowly Attained—Nature the First Artificer.*—The next step from the stone age, so far as further appeal to ancient implements can guide us, is also exactly what one would expect. It is to a better stone age. Two distinct grades of stone implements are found, the rough and the smooth, or the unground and the ground. For a long period the idea never seems to have dawned that a smooth stone made a better ax than a rough one. Mind was as yet unequal to this small discovery, and there are vast remains representing long intervals of time where all the stone implements and tools are of the unground type. Even when the hour did come, when savage vied with savage in putting the finest polish on his flints, his inspiration probably came from nature. The first lapidary was the sea; the smoothed pebble on the beach, or the rounded stone of the mountain stream, supplied the pattern.—DRUMMOND *Ascent of Man*, p. 140. (J. P., 1900.)

89. ADVANCE OF SOLAR PHOTOGRAPHY—*Incessant Record of the Sun by Its Own Light.*—The first solar light-pictures of real value were taken, and the autographic record of the solar condition recommended by Sir John Herschel was commenced and continued at Kew during fourteen years—1858-72. The work of photographing the sun is now carried on in every quarter of the globe, from the Mauritius to Massachusetts, and the days are few indeed on which the self-betrayal of the camera can be evaded by our chief luminary. In the year 1883 the incorporation of Indian with Greenwich pictures afforded a record of the state of the solar surface on 340 days; and 360 were similarly provided for in 1885.—CLERKE *History of Astronomy*, pt. ii, ch. 2, p. 191. (Bl., 1893.)

90. ADVANCE THROUGH STRUGGLE—*Sentence of Death on All Who Fail.*—We find that this hideous hatred and strife, this wholesale famine and death, furnish the indispensable conditions for the evolution of higher and higher types of life. Nay, more; but for the pitiless destruction of all individuals that fall short of a certain degree of fitness to the circumstances of life into which they are born, the type would inevitably degenerate, the life would become lower and meaner in kind. Increase in richness, variety, complexity of life is gained only by the selection of variations above or beyond a certain mean, and the prompt execution of a death sentence upon all the rest. —FISKE *Through Nature to God*, pt. ii, ch. 2, p. 65. (H. L. & Co., 1900.)

91. ADVANTAGE OF DIMINISHED LIGHT OF STARS—If the entire vault of heaven were covered with innumerable strata of stars, one behind the other, as with a wide-spread starry canopy, and light were undiminished in its passage through space, the sun would be distinguishable only by its

spots, the moon would appear as a dark disk, and amid the general blaze not a single constellation would be visible.—HUMBOLDT *Cosmos*, vol. iii, p. 103. (H., 1897.)

92. ADVANTAGE OF TROPICS FOR NATURE-STUDY—*All Forms Represented—Climates Ranged Stage by Stage on Mountainsides.*—The countries bordering on the equator possess another advantage. . . . This portion of the surface of the globe affords in the smallest space the greatest possible variety of impressions from the contemplation of nature. Among the colossal mountains of Cundinamarca, of Quito, and of Peru, furrowed by deep ravines, man is enabled to contemplate alike all the families of plants, and all the stars of the firmament. There, at a single glance, the eye surveys majestic palms, humid forests of bambusa, and the varied species of musaceæ, while above these forms of tropical vegetation appear oaks, medlars, the sweet-brier, and umbelliferous plants, as in our European homes. There, as the traveler turns his eyes to the vault of heaven, a single glance embraces the constellation of the Southern Cross, the Magellanic clouds, and the guiding stars of the constellation of the Bear, as they circle round the arctic pole. There the depths of the earth and the vaults of heaven display all the richness of their forms and the variety of their phenomena. There the different climates are ranged the one above the other, stage by stage, like the vegetable zones, whose succession they limit; and there the observer may readily trace the laws that regulate the diminution of heat, as they stand indelibly inscribed on the rocky walls and abrupt declivities of the Cordilleras.—HUMBOLDT *Cosmos*, vol. i. int., p. 32. (H., 1897.)

93. ADVANTAGES OF NORTH AMERICA FOR COMMERCE—*Command of Two Oceans—Abundant Harbors.*—North America, and particularly the part of it held by the United States, is more advantageously placed in relation to marine navigation than any other equally extensive portion of the lands of the earth. Owing to the shape and position of this continent, it faces the two great divisions of oceanic waters, the Atlantic and the Pacific, and nearly all parts of its area are readily accessible from the shore by rivers or relatively short railways. At no point on its coast-line do we find a stretch of shore of more than three hundred miles in length which is without a haven suitable for modern shipping or which cannot readily be made into a good harbor.—SHALER *Sea and Land*, p. 159. (S., 1894.)

94. ADVANTAGES OF THE SPECTROSCOPE—*Chromosphere of Sun Studied without Waiting for Eclipse.*—Until recently, the solar atmosphere could be seen only at an eclipse, when the sun itself is hidden by the moon. Now, however, the spectroscope has brought the chromosphere and the prominences within the range of daily observation, so that they can be studied with nearly the same facility as the spots and faculæ, and a fresh field of great interest and importance is thus opened to science. It seems hardly possible that the ancients should have failed to notice, even with the naked eye, in some one of the many eclipses on record, the presence of blazing starlike objects, around the edge of the moon, but we find no mention of anything of the kind, altho the corona is described as we see it now.—YOUNG *The Sun*, ch. 6, p. 193. (A., 1898.)

95. ADVANTAGES TRANSMITTED BY HEREDITY—*Improvement by Breeding from Best Specimens.*—If we grow plants from seed or breed any kind of animals year after year, consuming or giving away all the increase we do not wish to keep just as they come to hand, our plants or animals will continue much the same; but if every year we carefully save the best seed to sow and the finest or brightest colored animals to breed from, we shall soon find that an improvement will take place, and that the average quality of our stock will be raised. This is the way in which all our fine garden fruits and vegetables and flowers have been produced, as well as all our splendid breeds of domestic animals; and they have thus become in many cases so different from the wild races from which they originally sprang as to be hardly recognizable as the same. It is therefore proved that if any particular kind of variation is preserved and bred from, the variation itself goes on increasing in amount to an enormous extent; and the bearing of this on the question of the origin of species is most important.—WALLACE *Darwinism*, ch. 1, p. 8. (Hum., 1889.)

96. AERONAUT, SPIDER AS—*Ascending Current in Still Air.*—One day, at Santa Fé, a spider which was about three-tenths of an inch in length, and which in its general appearance resembled a citigrade (therefore quite different from the gossamer), while standing on the summit of a post, darted forth four or five threads from its spinners. These, glittering in the sunshine, might be compared to diverging rays of light; they were not, however, straight, but in undulations like films of silk blown by the wind. They were more than a yard in length, and diverged in an ascending direction from the orifices. The spider then suddenly let go its hold of the post, and was quickly borne out of sight. The day was hot and apparently quite calm; yet under such circumstances the atmosphere can never be so tranquil as not to affect a vane so delicate as the thread of a spider's web. If during a warm day we look either at the shadow of any object cast on a bank, or over a level plain at a distant landmark, the effect of an ascending current of heated air

is almost always evident: such upward currents, it has been remarked, are also shown by the ascent of soap-bubbles, which will not rise in an indoors room. Hence I think there is not much difficulty in understanding the ascent of the fine lines projected from a spider's spinners, and afterwards of the spider itself.—DARWIN *Naturalist's Voyage Around the World*, ch. 8, p. 161. (A., 1898.)

97. AFFECTION AMONG PRIMITIVE PEOPLES—*Caribs, Papuans, Kurubars—Conflicting Reports of Observers.*—Under favorable circumstances, where food is not too scarce nor war too wasting, the life of low barbaric races may be in its rude way good and happy. In the West Indian islands, where Columbus first landed, lived tribes who have been called the most gentle and benevolent of the human race. Schomburgk, the traveler, who knew the warlike Caribs well in their home life, draws a paradise-like picture of their ways, where they have not been corrupted by the vices of the white men; he saw among them peace and cheerfulness and simple family affection, unvarnished friendship, and gratitude. . . . At the other side of the world, in New Guinea, Kops, the Dutch explorer, gives much the same account of the Papuans of Dory, who live in houses built on piles in the water, like the old lake-men of Switzerland; he speaks of their mild disposition, their inclination to right and justice, their strong moral principles, their respect for the aged and love for their children, their living without fastenings to their houses—for theft is considered by them a grave offense, and rarely occurs. Among the rude non-Hindu tribes of India, English officials have often recorded with wonder the kindliness and cheerfulness of the rude men of the mountains and the jungle, and their utter honesty in word and deed. Thus Sir Walter Elliot mentions a low poor tribe of South India, whom the farmers employ to guard their fields, well knowing that they would starve rather than steal the grain in their charge. [Their veracity is proverbial.] Of course, these accounts of Caribs and Papuans show them on the friendly side, while those who have fought with them call them monsters of ferocity and treachery. But cruelty and cunning in war seem to them right and praiseworthy; and what we are here looking at is their home peace-life. It is clear that low barbarians may live among themselves under a fairly high moral standard, and this is the more instructive because it shows what may be called natural morality. —TYLOR *Anthropology*, ch. 16, p. 406. (A., 1899.)

98. AFFECTION, CONJUGAL, WANTING AMONG SAVAGES—*Of Slow Growth in Civilization—Australian — Brahman.*—We have another and a more serious count against early fatherhood. If the love of father for child was in this backward state, infinitely more grave was the condition of things between him and the mother. Probably we have all taken it for granted that husbands and wives have always loved one another. . . . There have been and still are tribes and nations where love between husband and wife is non-existent. Among the Hovas, we are assured by authorities, the idea of love between husband and wife is "hardly thought of"; that at Winnebah "not even the appearance of affection" exists between them; that among the Beni-Amer it is "considered even disgraceful for a wife to show any affection for her husband"; that the Chittagong Hill tribes have "no idea of tenderness nor of chivalrous devotion"; and that the Eskimo treat their wives "with great coldness and neglect." The savage cruelty with which wives are treated by the Australian aborigines is indicated even in their weapons. The very names, "servant, slave," by which the Brahman address their wives, and the wife's reply, "master, lord," symbolize the gulf between the two. There are exceptions, it is true, and often touching exceptions. Travelers cite instances of constancy among savage peoples which reach the region of romance. Probably there never was a time, indeed, nor a race, when some measure of sympathy did not stir between husband and wife. But when we consider all the facts, it is impossible to doubt that in the region of all the higher affections the savage wife and the savage husband were all but strangers to each other.—DRUMMOND *Ascent of Man*, p. 300. (J. P., 1900.)

99. AFFECTIONS, ORGANIC, ACT UPON THE MIND—*Hopefulness of Consumptives Due to Accelerated Breathing.*—It is natural to suppose that the passion which a particular organ produces in the mind will be that which, when otherwise excited, discharges itself specially upon that organ. . . . When we consider the effects which a joyful anticipation, or the elation of a present excitement, has upon the lungs—the accelerated breathing and the general bodily exhilaration which it occasions—we cannot help thinking of the strange hopefulness and the sanguine expectations of the consumptive patient, who, on the edge of the grave, projects, without a shadow of distrust, what he will do long after he will have been "green in death and festering in his shroud." Observe how fear strikes the heart, and what anxious fear and apprehension accompany some affections of the heart. Anger, disappointment, and envy notably touch the liver; which, in its turn, when deranged, engenders a gloomy tone of mind through which all things have a malignant look, and from which, when philosophy avails not to free us, the restoration of its functions will yield instant relief. The internal organs are plainly not the agents of their special functions only, but, by reason of the intimate consent or sympathy of

functions, they are essential constituents of our mental life.—MAUDSLEY *Body and Mind,* lect. 1, p. 37. (A., 1898.)

100. AFFINITY, CHEMICAL, AND ELECTRICITY—Any chemical reaction which occurs between conducting substances may be utilized to generate electric currents. The chemical affinity both supplies and measures exactly the electro-motive force—BENJAMIN *Age of Electricity,* ch. 4, p. 41. (S., 1897.)

101. AFFLICTION MAY STRENGTHEN—*People of Iceland—Many Perils and High Achievement.*—Care must be taken not to make too much account of the effect exercised by the great convulsions of nature on the moral condition of a people. The need of this precaution is well shown by the social history of Iceland. This country has for the thousand years of its history been subjected to imminent peril from the instability of the earth as well as from the inhospitable nature of its climate. In almost every century of the world's history famine caused by the accidents of the earth and air has menaced the life of the population. Many successive volcanic outbreaks, attended by serious earthquakes, have convulsed this island, and yet amid these mishaps the people have maintained the highest measure of social order in any state of which we have a history. The Icelanders have had the moral strength to rise superior to such afflictions. In this state, as in certain individuals, chastisement which would have destroyed weaker natures served to affirm the vigor of the strong people.—SHALER *Aspects of the Earth,* p. 20. (S., 1900.)

102. AGENCY, HUMAN, RECOGNIZED IN ARROW-HEAD—*Instant Conviction of Its Human Origin.*—Many years ago, as I was walking in a garden in the neighborhood of Edinburgh, my eye wandered over the materials which had been freshly scattered on the path. Suddenly, and very unexpectedly, it lighted on a fragment unlike the rest, and unlike them in a way which instantly carried its own explanation on its face. All the other fragments were works of nature. This one fragment was certainly a work of human art. It was a very small, but a very perfect arrow-head, made of yellow flint. What was it that made its artificial origin so obvious at a glance? The physical forces of nature, it is true, had made it; but they had made it under special direction and control. The physical forces of nature, working by themselves, under no special direction or control, could never have made that arrow-head. No mere splitting by frost, no mere chipping by accidental collision with other fragments, still less any wearing by rivers or by the sea, could possibly have molded that perfect symmetry of form, with its sharpened point, with its two lateral barbs, and with the little shank between them. But all this reasoning was an afterthought. In coming to my conclusion, I was not conscious of any reasoning. The recognition was instantaneous. It was the recognition in that fragment, alone of all the fragments round it, of two things which of all others are the most familiar to us. The first of these was the adaptation of material and of form to a known end, and the second of these was that particular mechanical method by which the particular animal man makes the adaptations he intends.—ARGYLL *Unity of Nature,* ch. 5, p. 106. (Burt.)

103. AGENCY MANIFEST—*The Wrong Agent Suspected—The Scattering of Its Seeds by Wistaria.*—In December, while absent from home, I collected for future study some pods of the Chinese wistaria, and left them on my desk in the library for the night. The house was heated by a hot-air furnace. In the morning the pods were in great confusion; most of them had split and curled up, and the seeds were scattered all about the room. As usual the little daughter, an only child, was accused of spoiling my specimens, but she showed her innocence. A little investigation and a few experiments with some pods not yet opened explained the whole matter satisfactorily. The stout pods grow and ripen in a highly strained condition, with a strong tendency to burst spirally, the two half-pods being ready to coil and spring in opposite directions; when the valves can no longer hold together, they snap with a sharp noise and sling the heavy seeds, giving them a good send-off into the world. As a pair of birds built a nest, hatch eggs, rear their young, and then send them forth to seek their fortunes, so for months the mother plant had labored, had produced and matured seeds, which at last it scattered broadcast.—BEAL *Seed Dispersal,* ch. 6, p. 58. (G. & Co., 1898.)

104. AGENCY OF CONTRASTED FORCES IN UNITED WORK—*Fire and Water Jointly Build the Crust of the Earth.*—Water is a very active agent of destruction, but it works over again the materials it pulls down or wears away, and builds them up anew in other forms. As soon as an ocean washed over the consolidated crust of the globe, it would begin to abrade the surfaces upon which it moved, gradually loosening and detaching materials, to deposit them again as sand or mud or pebbles at its bottom in successive layers, one above another. Thus, in analyzing the crust of the globe, we find at once two kinds of rocks, the respective work of fire and water: the first poured out from the furnaces within, and cooling, as one may see any mass of metal cool that is poured out from a smelting-furnace to-day, in solid crystalline masses, without any division into separate layers or leaves; and the latter in successive beds, one over another, the heavier materials below, the lighter above, or

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sometimes in alternate layers, as special causes may have determined successive deposits of lighter or heavier materials at some given spot.—AGASSIZ *Geological Sketches*, ser. i, ch. 1, p. 5. (H. M. & Co., 1896.)

105. AGENCY, UNCONSCIOUS — *Insects Allured by Nectar Carry Away Adhering Pollen—Narrow Self-seeking Fulfils Wide Design.*—Small insects alight on the labellum of the *Listera ovata* for the sake of the nectar copiously secreted by it; as they lick this they slowly crawl up its narrowed surface until their heads stand directly beneath the overarching crest of the rostellum; when they raise their heads they touch the crest; this then explodes, and the pollinia are instantly and firmly cemented to their heads. As soon as the insect flies away, it withdraws the pollinia, carries them to another flower, and there leaves masses of the friable pollen on the adhesive stigma.—DARWIN *Fertilization of Orchids*, ch. 4. p. 119. (A., 1898.)

106. AGENT LOST IN RESULT—*Heat Disappears in Work.*—We can raise a weight by heat; and in this agent we possess an enormous store of mechanical power. A pound of coal produces by its combination with oxygen an amount of heat which, if mechanically applied, would suffice to raise a weight of 100 pounds to a height of twenty miles above the earth's surface. Conversely, 100 pounds falling from a height of twenty miles, and striking against the earth, would generate an amount of heat equal to that developed by the combustion of a pound of coal. Wherever work is done by heat, heat disappears. A gun which fires a ball is less heated than one which fires blank cartridge. The quantity of heat communicated to the boiler of a working steam-engine is greater than that which could be obtained from the recondensation of the steam, after it had done its work; and the amount of work performed is the exact equivalent of the amount of heat lost.—TYNDALL *Fragments of Science*, vol. i, ch. 16, p. 373. (A., 1897.)

107. AGENT OF DESTRUCTION VANISHES, RUIN REMAINS—*Explosion of Volcano Likened to Bursting of a Boiler.*—We may compare the explosion of a volcano to the action of a bursting boiler, when in a moment the rupturing agent disappears in the air, leaving only the fragments of the vessel which contained it and which it has torn to pieces.—SHALER *Aspects of the Earth*, p. 65. (S., 1900.)

108. AGE OF DEEP-SEA ORGANISMS—*Oldest Genera at Greatest Depths.*—Agassiz points out that all those genera that have the greatest bathymetrical range, extending from the littoral to the abysmal region, are at the same time genera which date back to the cretaceous period, while those having a somewhat more limited range go back to the tertiaries, and those that extend only slightly beyond the littoral area go back only to the later tertiaries.

This interesting generalization brings home to our minds the enormous length of time that it must have taken these animals to migrate from the shallow to the deep sea. In the struggles for existence between marine animals it must always have been the last resort of those unable to compete with the younger generations in shallow water to migrate into the deeps.

The scarcity of food, the darkness, and the pressure of these regions can never be so favorable for the support of animals as the conditions of the shores. We can well imagine that a species would take every opportunity that is afforded to return from such inhospitable habitats, and that only when, as it were, every door is closed, when no island, continent, or cape can afford it a free scope for life in shallow water, does it become a true deep-sea species.—HICKSON *Fauna of the Deep Sea*, ch. 5, p. 103. (A., 1894.)

109. AGE OF SEQUOIAS—*Brevity of Human Life and Fame.*—So far as we can judge from the actual counting of the layers of several trees, no sequoia now alive sensibly antedates the Christian era. . . . That the more remarkable of these trees should bear distinguishing appellations seems proper enough; but the tablets of personal names which are affixed to many of them in the most visited groves—as if the memory of more or less notable people of our day might be made enduring by the juxtaposition—do suggest some incongruity. When we consider that a hand's breadth at the circumference of any one of the venerable trunks so placarded has recorded in annual lines the lifetime of the individual thus associated with it, one may question whether the next hand's breadth may not measure the fame of some of the names thus ticketed for adventitious immortality. Whether it be the man or the tree that is honored in the connection, probably either would live as long, in fact and in memory, without it.—ASA GRAY *Darwiniana*, art. 5, p. 207. (A., 1889.)

110. AGE OF TREES—*Yew, Linden, and Eucalyptus—Relative Brevity of Human Life.*—Decandolle finds that of all European species of trees the yew attains the greatest age; and according to his calculations thirty centuries must be assigned as the age of the *Taxus baccata* of Braburn in Kent, from twenty-five to twenty-six to the Scotch yew of Fortingal, and fourteen and one-half and twelve respectively to those of Crowhurst in Surrey and Ripon (Fountains Abbey) in Yorkshire. Endlicher remarks that "another yew-tree in the churchyard of Grasford, North Wales, which measures more than fifty feet in girth below the branches, is more than 1,400 years old, whilst one in Derbyshire is estimated at

2,096 years. In Lithuania linden trees have been felled which measured eighty-seven feet round, and in which 815 annular rings have been counted." In the temperate zone of the southern hemisphere some species of the eucalyptus attain an enormous girth, and as they at the same time attain a height of nearly 250 feet, they afford a singular contrast to our yew-trees, which are colossal only in thickness. Mr. Backhouse found in Emu Bay, on the shore of Van Diemen's Land, eucalyptus trunks which, with a circumference of seventy feet at the base, measured as much as fifty feet at a little more than five feet from the ground.—HUMBOLDT *Views of Nature*, p. 274. (Bell, 1896.)

111. AGES OF GEOLOGY—*Early Geologists Grasped Essentials.*—Altho subsequent investigations have multiplied extensively the number of geological periods, . . . yet the first general division into three great eras [primary, secondary, and tertiary] was nevertheless founded upon a broad and true generalization. In the first stratified rocks in which any organic remains are found, the highest animals are fishes, and the highest plants are cryptogams; in the middle periods reptiles come in, accompanied by fern and moss forests; in later times quadrupeds are introduced, with a dicotyledonous vegetation. So closely does the march of animal and vegetable life keep pace with the material progress of the world, that we may well consider these three divisions, included under the first general classification of its physical history, as the three ages of nature; the more important epochs which subdivide them may be compared to so many great dynasties, while the lesser periods are the separate reigns contained therein.—AGASSIZ *Geological Sketches*, ser. i, ch. 1, p. 15. (H. M. & Co., 1896.)

112. AGES PRECEDING HUMAN HISTORY—*Momentary Life of Man.*—How these grand contemplations enlarge the ideas which we habitually form of nature! We imagine that we go very far back in the past in contemplating the old pyramids still standing on the plains of Egypt, the obelisks engraved with mysterious hieroglyphics, the silent temples of Assyria, the ancient pagodas of India, the idols of Mexico and Peru, the time-honored traditions of Asia and of the Aryans, our ancestors, the instruments of the stone age, the flint weapons, the arrows, the lances, the knives, the sling-stones of our primitive barbarism—we scarcely dare to speak of ten thousand, of twenty thousand years. But even if we admit a hundred thousand years for the age of our species, so slowly progressive, what is even this compared with the fabulous succession of ages which have preceded us in the history of the planet!—FLAMMARION *Popular Astronomy*, bk. i, ch. 7, p. 77. (A.)

113. AGNOSTIC AGREES WITH SCRIPTURE—*"Neither Can He Know Them" (1 Cor. ii, 14)—No Prohibition, but a Statement of Fact.*—It is no spell of ignorance arbitrarily laid upon certain members of the organic kingdom that prevents them reading the secrets of the spiritual world. It is a scientific necessity. No exposition of the case could be more truly scientific than this: "The natural man receiveth not the things of the spirit of God; for they are foolishness unto him; neither can he know them, because they are spiritually discerned." The verb here, it will be again observed, is potential. This is not a dogma of theology, but a necessity of science. And science, for the most part, has consistently accepted the situation. It has always proclaimed its ignorance of the spiritual world. When Mr. Herbert Spencer affirms, "Regarding science as a gradually increasing sphere we may say that every addition to its surface does not but bring it into wider contact with surrounding nescience," from his standpoint he is quite correct. The endeavors of well-meaning persons to show that the agnostic's position, when he asserts his ignorance of the spiritual world, is only a pretense; the attempts to prove that he really knows a great deal about it, if he would only admit it, are quite misplaced. He really does not know. The verdict that the natural man receiveth not the things of the spirit of God, that they are foolishness unto him, that neither can he know them, is final as a statement of scientific truth—a statement on which the entire agnostic literature is simply one long commentary.—DRUMMOND *Natural Law in the Spiritual World*, int., p. 69. (H. Al.)

114. AGNOSTICISM—*A Witness for Christian Truth.*—The Pauline anthropology has been challenged as an insult to human nature. Culture has opposed the doctrine that "The natural man receiveth not the things of the spirit of God, for they are foolishness unto him: neither can he know them, because they are spiritually discerned" (I Cor. ii, 14). . . . The history of thought during the present century proves that the world has come round spontaneously to the position of the first. One of the ablest philosophical schools of the day erects a whole anti-christian system on this very doctrine. Seeking by means of it to sap the foundation of spiritual religion, it stands unconsciously as the most significant witness for its truth. What is the creed of the agnostic but the confession of the spiritual numbness of humanity? The negative doctrine which it reiterates with such sad persistency, what is it but the echo of the oldest of scientific and religious truths? And what are all these gloomy and rebellious infidelities, these touching and too sincere confessions of universal nescience, but a protest against this ancient law of

death?—DRUMMOND *Natural Law in the Spiritual World*, p. 143. (H. Al.)

115. ——— ——— *Hopelessness of.*—The agnostic evolution thus leaves us as orphans in the midst of a cold and insensate nature. We are no longer dwellers in our Father's house, beautiful and fitted for us, but are thrown into the midst of a hideous conflict of dead forces, in which we must finally perish and be annihilated. In a struggle so hopeless it is a mere mockery to tell us that in millions of years something better may come out of it; for we know that this will be of no avail to us, and we feel that it is impossible. Thus the agnostic philosophy, if it be once accepted as true, seriously raises the question whether life is worth living.—DAWSON *Facts and Fancies in Modern Science*, lect. 1, p. 99. (A. B. P. S.)

116. ——— ——— *Its Hypotheses Need a God.*—An excellent judge, a gifted adept in physical science and exact reasoning, the late Clerk-Maxwell, is reported to have said, not long before he left the world that he had scrutinized all the agnostic hypotheses he knew of, and found that they one and all needed a God to make them workable.—ASA GRAY *Natural Science and Religion*, lect. 2, p. 91. (S., 1891.)

117. AGREEMENT OF INDEPENDENT THINKERS—*Wallace and Darwin Reach the Same Conclusion.*—Such being the general ferment in the minds of naturalists, it is no wonder that they mustered strong in the rooms of the Linnæan Society, on the 1st of July of the year 1858, to hear two papers by authors living on opposite sides of the globe, working out their results independently, and yet professing to have discovered one and the same solution of all the problems connected with species. The one of these authors was an able naturalist, Mr. Wallace, who had been employed for some years in studying the productions of the islands of the Indian Archipelago, and who had forwarded a memoir embodying his views to Mr. Darwin, for communication to the Linnæan Society. On perusing the essay Mr. Darwin was not a little surprised to find that it embodied some of the leading ideas of a great work which he had been preparing for twenty years, and parts of which containing a development of the very same views, had been perused by his private friends fifteen or sixteen years before. Perplexed in what manner to do full justice both to his friend and to himself, Mr. Darwin placed the matter in the hands of Dr. Hooker and Sir Charles Lyell, by whose advice he communicated a brief abstract of his own views to the Linnæan Society, at the same time that Mr. Wallace's paper was read. Of that abstract the work on the "Origin of Species" is an enlargement.—HUXLEY *Lay Sermons*, serm. 12, p. 291. (G. P. P., 1899.)

118. AGREEMENT OF PLANT AND ANIMAL—*Each an Aggregate of Units.*—The substance of our recent knowledge is that a plant is an aggregate of organic units, mostly of very small size; that these are to the herb or tree what the bricks and stones are to the edifice. Only they "are living stones, fitly framed together" in organic growth, and their walls answer to the cement. Animals do not differ materially, except that the mortar is mostly of the same nature as the bricks, and there is a greater or at length complete fusion or confluence of the cells. The component material, the protoplasm, is essentially the same.—ASA GRAY *Natural Science and Religion*, lect. 1, p. 30. (S., 1891.)

119. AGREEMENT OF SUN AND MOON IN APPARENT SIZE—*Dependence of Astronomy on Seeming Accident.*—If the moon had a disk much smaller than the sun's there would never be a total eclipse of the sun, and all those wonderful objects which make their appearance when the sun is totally eclipsed—the colored prominences and the sierra, the glowing inner corona, and the radiated fainter glory which lies outside the corona—would have been altogether unknown to us. But we should scarcely have learned more if the moon had had a disk much larger than the sun's. For in that case, when a total eclipse began all the region round the sun, except that close to the part of the sun's face concealed last, would be hidden by the moon's much larger disk. . . . We now see during totality the complete ring of prominences for two or three minutes, and the whole of the corona is shown. Even as thus shown it has been sufficiently difficult to ascertain the nature of these objects. But with a moon much larger than ours we could have learned scarcely anything respecting them, and with a moon much smaller we should have known absolutely nothing of the solar appendages. —PROCTOR *Expanse of Heaven*, p. 38. (L. G. & Co., 1897.)

120. AGRICULTURE AIDED BY CHEMISTRY—*The Fertilization of Soils.*—Chemical analysis taught the farmer that, to a certain depth, his field contains only a very limited amount of what is required to grow plants, and in what form a fertilizing substance is able to afford nourishment. It showed him also that stable manure, excellent as it is, is not adequate for sustaining the farm's products; that to farm with nothing but stable manure produced upon the farm could not increase the amount of nourishing substances in the soil, but would only set these in motion and displace them; that he could not contribute to the surface of an exhausted grain field what he had just withdrawn from the field beneath by means of the plants for fodder; that he was not giving to any field more than he was taking from it, or otherwise, only at the expense of some other field; that the revenue from a

farm tilled wholly by means of stable manure was like a life-annuity—it was using up his capital.—LIEBIG *Addresse vor der öffentlichen Sitzung der königlichen Akademie der Wissenschaften, Munich, 1861.* (Translated for *Scientific Side-Lights.*)

121. AGRICULTURE AND COMMERCE, PRIMITIVE—*Lake-dwellers of Switzerland.*—The lake-inhabitants of Switzerland cultivated several kinds of wheat and barley, the pea, the poppy for oil and flax; and they possessed several domesticated animals. They also carried on commerce with other nations.—DARWIN *Origin of Species*, ch. 1, p. 16. (Burt.)

122. AGRICULTURE AN EARLY INVENTION—*Beginnings of, among Savages—Purpose, Industry, and Settled Life Required.*—Man, even while he feeds himself as the lower animals do, by gathering wild fruit and catching game and fish, is led by his higher intelligence to more artificial means of getting these. Rising to the next stage, he begins to grow supplies of food for himself. Agriculture is not to be looked on as a difficult or out-of-the-way invention, for the rudest savage, skilled as he is in the habits of the food-plants he gathers, must know well enough that if seeds or roots are put in a proper place in the ground they will grow. Thus it is hardly through ignorance, but rather from roving life, bad climate, or sheer idleness, that so many tribes gather what nature gives, but plant nothing. Even very rude people, when they live on one spot all the year round, and the climate and soil are favorable, mostly plant a little, like the Indians of Brazil, who clear a patch of forest round their huts to grow a supply of maize, cassava, bananas, and cotton.—TYLOR *Anthropology*, ch. 9, p. 214. (A., 1899.)

123. AGRICULTURE, PRIMITIVE, OF NORTH AMERICA—*An Original Product—Maize.*—But American agriculture was not imported from abroad; it resulted from, and in return rendered possible, the gradual development of American semi-civilization. This is proved by the fact that the grains of the Old World were entirely absent, and that American agriculture was founded on the maize, an American plant.—AVEBURY *Prehistoric Times*, ch. 8, p. 264. (A., 1900.)

124. AGRICULTURE, PRIMITIVE, WOMAN'S WORK IN—A company of Cocopa or Mohave or Pima women set forth to a rich and favored spot on the side of a cañon or rocky steep. They are guarded by a sufficient number of men from capture or molestation. Each woman has a little bag of gourd-seed, and when the company reach their destination she proceeds to plant the seeds one by one in a rich cranny or crevice where the roots may have opportunity to hold, the sun may shine in, and the vines with their fruit may swing down as from a trellis. The planters then go home and take no further notice of their vines until they return in the autumn to gather the gourds. This is the testimony of E. Palmer, who spent many years as a collector among the American aborigines. Seed-time and harvest: no preparation of the soil, no tending of the young plants; ingathering, that is all.—MASON *Origins of Invention*, ch. 6, p. 192. (S., 1899.)

125. AGRICULTURE, THE FIRST OF ALL IMPLEMENTS IN—After all has been said about other devices, the digging-stick is the beginning of agricultural implements, the progenitor of the hoe, the spade, the plow. It would be difficult to find a tribe so low down as not to know its use.—MASON *Origins of Invention*, ch. 6, p. 190. (S., 1899.)

126. AGRICULTURE THE FOUNDATION OF CIVILIZATION—All civilization is the outgrowth of strivings which go beyond momentary physical needs; and therefore until agriculture affords a firm foundation for subsistence, until life is by the soil made something more than a struggle for momentary support, the foundations of culture cannot be obtained.—SHALER *Nature and Man in America*, ch. 5, p. 170. (S., 1899.)

127. AIR, EXCLUSION OF, QUENCHES FIRE—*Danger of Flight with Burning Garments—Invisible Food of Combustion.*—The flame of an ordinary lantern or lamp, where a chimney is employed, would not burn more than a few minutes if holes were not provided at the base for the ingress of air. But for the occasional application of the poker, the combustion of a common fire would be maintained with difficulty, or prematurely put an end to, for the oxygen of the air must find free access to the interior of the burning mass, or the chemical decompositions we are about to describe cannot take place. On the same principle the best way of extinguishing fire is to smother it; that is, to cover it closely with something that will effectually cut off the source of its existence. If the clothes of some unfortunate friend should happen to catch fire, the best course to follow is to throw him down and envelop him in a rug, blanket, or anything of a similar kind within reach, when the flames will be immediately extinguished. To run about in search of water or assistance in these cases is simply to give time to the flames to reach a vital part of the body.—LOWE *Nature-Studies*, p. 2. (Hum., 1888.)

128. AIR MADE LIQUID—*A Perfect Refrigerant.*—In many of its chapters the history of invention displays an advance from the roundabout to the direct, as we have seen in the substitution of the steam-turbine for the compound engine. Recent modes of refrigeration offer a like illustration. For some years the plan was to employ a series of chemical compounds, each

with a lower boiling-point than its predecessor in the process, and all troublesome and hazardous in manipulation. A better method has been developed by keeping to simple air from first to last. In the Tripler machine air is first compressed to 65 pounds pressure to the square inch; through a second pump this pressure is exalted to 400 pounds, and with a third pump the pressure is carried to 2,500 pounds. After each compression the air flows through jacketed pipes, where it is cooled by a stream of water. At the third condensation a valve, the secret of whose construction Mr. Tripler keeps to himself, permits part of the compressed air to flow into a pipe surrounding the tube through which the remainder is flowing. This act of expansion severely chills the imprisoned air, which at last discharges itself in liquid form—much as water does from an ordinary city faucet.—ILES *Flame, Electricity, and the Camera,* ch. 6. p. 72. (D. & McC.. 1900.)

129. AIR, MAN'S DEPENDENCE UPON —*Bad Air Cannot Always Be Rejected.*—Solicitude with regard to the hostile influences contained within our mixture of air is gradually becoming greater. We are conscious of the 9,000 liters of air we are daily consuming; we might almost grow disheartened before the avowal that this consumption is something compulsory, uninterrupted; that we cannot refuse spoiled air as we can any doubtful, disgusting article of food; that it is not in our power to wait for hours, or even several minutes, until better air can be furnished. Breathe or die, there can be no haggling.—WERNICH *Ueber gute und schlechte Luft,* lect. A lecture. (Translated for *Scientific Side-Lights.)*

130. AIR, PURIFIED, PUTREFACTION IMPOSSIBLE IN—*Tyndall's Glycerin-coated Cabinet.*—A few years after Pasteur's first work on this subject Tyndall (1868) conceived a precise method of determining the absence or presence of dust particles in the air by passing a beam of sunlight through a glass box before and after its walls had been coated with glycerin. Into the floor of the box were fixed the mouths of flasks of infusion. These were boiled, after which they were allowed to cool, and might then be kept for weeks or months without putrefying or revealing the presence of germ life. Here all the conditions of the infusions were natural, except that in the air above them there was no dust. The sum-total of result arising from all these investigations was to the effect that no spontaneous generation was possible, that the atmosphere contained unseen germs of life, that the smallest of organisms responded to the law of gravitation and adhered to moist surfaces, and that micro-organisms were in some way or other the cause of putrefaction.—NEWMAN *Bacteria,* ch. 1, p. 4. (G. P. P., 1899.)

131. ALCOHOL A POISON—*Destroys the Life That Produced It—Necessary Limit to Strength of Fermented Liquors.*—We shall have to consider a remarkable faculty which some bacteria possess of producing products inimical to their own growth. In some degrée this is true of the yeasts, for when they have set up fermentation in a saccharine fluid there comes a time when the presence of the resulting alcohol is injurious to further action on their part. It has become indeed a poison, and, as we have already mentioned, a necessary condition for the action of a ferment is the absence of poisonous substances. This limit of fermentation is reached when the fermenting fluid contains 13 or 14 per cent. of alcohol. —NEWMAN *Bacteria,* ch. 4, p. 119. (G. P. P., 1899.)

132. ALCOHOL DESTROYS VOLITION —*Confirmed Alcoholism—Power and Responsibility in Early Stages.*—It may be confidently stated as a result of universal experience that our "capacity of willing," that is, of giving a preponderance to the motive on which we elect to act, depends, first, upon our conviction that we really have such a self-determining power, and, secondly, upon our habitual exercise of it. The case, which is unfortunately but too common, of a man who habitually gives way to the desire for alcoholic excitement, and is ruining himself and his family by his self-abandonment, will bring into distinct view the practical bearing of the antagonistic doctrines.

The automatism of his nature (purely physical so far as the bodily craving for alcohol is concerned, but including, in most cases, some play of social instincts) furnishes an aggregate of powerful attractions to the present gratification. On the other side is an aggregate of moral deterrents, which, when the attention is fixed upon them in the absence of the attractive object, have a decided preponderance, so far as the desires are concerned. The slave of intemperance is often ready to cry out, "O wretched man that I am, who shall deliver me from the body of this death?"—and he proves his sincerity by his readiness to take every indirect precaution that does not interfere with his personal liberty. But when the temptation recurs, the force of the attraction is intensified by its actual presence; the direct sensory presentation makes a more vivid impression than the ideal representation of the deterrent motives; and the balance, which previously turned against the indulgence, now preponderates in favor of it. What, then, is it within the power of the ego to do? On the automatist theory, nothing. For not only is he unable to call to his aid any motive which does not spontaneously arise, but he cannot make any alteration in the relative strength of

the motives which are actually present to his consciousness. He says, to himself and to others, "I could not help yielding"; and automatism sanctions the plea. Society may be justified in imposing on him either restraint or punishment, alike for its own security and for his welfare; but no consistent automatist can regard him as an object of the moral reprobation which we instinctively feel for the self-degraded sot; and experience shows that the system of external repression almost invariably loses its potency as a deterrent as soon as the restraining influence is withdrawn.

Now, although I hold it beyond question that a state may be induced by habitual alcoholic indulgence in which the unhappy subject of it loses all power of resistance, I affirm it to be "the normal experience of healthy men" that the ordinary toper has such a power in the earlier stages of his decadence, and that he is justly held culpable for not exerting it.—CARPENTER *Mental Physiology*, pref., p. xxxix. (A., 1900.)

133. ALCOHOL, EFFECT OF—*Cumulative—How Small Doses of Poison Operate.*—Small quantities of poisonous substances, such as alcohol, for instance, may be indulged in for years without apparent injury. But finally the total effect of all these small quantities of poison will suddenly appear, not, perhaps, because of any accumulation of those small doses of the poison in the system, but because of an accumulation of their effects.—STRÜMPELL *in an address before the Naturforscher Versammlung, Nuremberg, 1893.* (Translated for *Scientific Side-Lights.*)

134. ——— ——— *Intoxication Allied to Mania—Results May Be Mental Derangement.*—Alcohol yields us, in its direct effects, the abstract and brief chronicle of the course of mania. At first there is an agreeable excitement, a lively flow of ideas, a revival of old ideas and feelings which seemed to have passed from the mind, a general increase of mental activity—a condition very like that which often precedes an attack of acute mania, when the patient is witty, lively, satirical, makes jokes or rimes, and certainly exhibits a brilliancy of fancy which he is capable of at no other time. Then there follows, in the next stage of its increasing action, as there does in mania, the automatic excitation of ideas which start up and follow one another without order, so that thought and speech are more or less incoherent, while passion is easily excited. After this stage has lasted for a time, in some longer, in others shorter, it passes into one of depression and maudlin melancholy, just as mania sometimes passes into melancholia, or convulsion into paralysis. And the last stage of all is one of stupor and dementia. If the abuse of alcohol be continued for years, it may cause different forms of mental derangement, in each of which the muscular are curiously like the mental symptoms: delirium tremens in one, an acute noisy and destructive mania in another, chronic alcoholism in a third, and a condition of mental weakness with loss of memory and loss of energy in a fourth.—MAUDSLEY *Body and Mind*, lect. 3, p. 91. (A., 1898.)

135. ALCOHOL, EFFECT OF—*Upon Children—Alcoholic Imbecility.*—But the greatest ravage is wrought upon the nervous system of the child by means of alcohol. We now are aware that there is no more certain method of breeding idiots than by the continuous administering of alcohol. Thousands of mothers are systematically poisoning their darlings by means of a substance which renders them stupid, languid, and without energy; and, according to circumstances, makes of them physical and mental cripples. Therefore away with this pernicious faith in the "strengthening" effect of alcohol, away with the "strengthening" wines for chronic conditions of weakness, anemia, and chlorosis; above all let us do away with alcoholic poisons in the nursery, that we may not lead the generation that is now growing up into sickness and degeneration with our own hands.—KRÄPELIN *A Lecture.* (Translated for *Scientific Side-Lights.*)

136. ALCOHOL IN BREAD INCONSIDERABLE—*A Disastrous Experiment.*—Not many years ago £20,000 was lost in the prosecution of a scheme for collecting the alcohol that distils from bread in baking, all which would have been saved to the subscribers had they known that less than a hundredth part by weight of the flour is changed in fermentation.—HERBERT SPENCER *Education*, chap. 1, p. 38. (A., 1900.)

137. ALCOHOL, IS IT A FOOD OR A POISON?—We are thus freed from the dilemma in which we were placed by admitting on the one hand that alcohol has no albumen-saving properties, as has been proven by many experiments, and by claiming for it on the other hand the power to save fat. For the two facts from which these contradictory assumptions have been deduced, namely, the absence of a diminution in the breaking up of albumen and the actually noted diminution in the breaking up of fat, far from being contradictory, are simply the necessary result of the toxic and deleterious action which alcohol exerts upon the protoplasm.

In this statement our final sentence against alcohol is pronounced. For the animal and human organism alcohol is not both a food and a poison, but only a poison, which, like all other poisons, is excitant when taken in small doses, while in larger ones it produces paralysis and death.—KASSOWITZ *Alkohol nährend oder toxisch? A Lecture: Werke*, p. 16. (Translated for *Scientific Side-Lights.*)

138. ALCOHOLISM IN THE FRONT RANK OF DISEASES—*Prevention of Disease Now the Watchword of Physicians—The Etiological Epoch in Medicine.*—The present epoch is rightly termed the etiological in medicine. We physicians now acknowledge that recognition of the causes of disease is one of the highest problems of our investigation, because we have become aware that by this means we pave the way not merely for the cure of disease, but also for the far more important—prevention of disease. But how many causes of disease can be found that for extent and importance are at all comparable to chronic alcohol intoxication? At the most there are two infectious diseases, tuberculosis and syphilis, that can be ranked with alcoholism in these respects. But how much more comprehensible, more manifest, more accessible to research and to medical influence are the effects of this chemical substance exactly known, as compared with the complicated biological influences of the parasite micro-organisms!—STRÜMPELL *Ueber die Alkoholfrage vom ärztlichen Standpunkt.* (Translated for *Scientific Side-Lights.)*

139. ALCOHOL PRODUCES CRIMINAL HEREDITY—*The Ancestry of Paris Prisoners.*—I have stated that the prisons are inhabited by degenerates. I might just as well have said, and with as much right, that they are inhabited by the sons of alcoholics. If, in the case of a criminal, we cannot refer to insanity, or hysteria, or epilepsy in the ancestry, we make inquiries regarding alcohol, and in nine cases out of ten we find that to be the root of the evil.—LAURENT *Les Habitués des Prisons de Paris,* p. 21. (Translated for *Scientific Side-Lights.)*

140. ALCOHOL VS. NUTRITION—*Privation a Cause of Intemperance—The Morality of Cookery.*—An instructive experience of my own will illustrate this. When wandering alone through Norway in 1856, I lost the track in crossing the Kjolen fjeld, struggled on for twenty-three hours without food or rest, and arrived in sorry plight at Lom, a very wild region. After a few hours' rest I pushed on to a still wilder region and still rougher quarters, and continued thus to the great Jostedal table-land, an unbroken glacier of 500 square miles; then descended the Jostedal itself to its opening on the Sogne fjord—five days of extreme hardship with no other food than flatbrod (very coarse oatcake) and bilberries gathered on the way, varied on one occasion with the luxury of two raw turnips. Then I reached a comparatively luxurious station (Ronnei), where ham and eggs and claret were obtainable. The first glass of claret produced an effect that alarmed me—a craving for more and for stronger drink, that was almost irresistible. I finished a bottle of St. Julien, and nothing but a violent effort of will prevented me from then ordering brandy.

I attribute this to the exhaustion consequent upon the excessive work and insufficient, unsavory food of the previous five days; have made many subsequent observations on the victims of alcohol, and have no doubt that overwork and scanty, tasteless food is the primary source of the craving for strong drink that so largely prevails with such deplorable results among the class that is the most exposed to such privation. I do not say that this is the only source of such depraved appetite. It may also be engendered by the opposite extreme of excessive luxurious pandering to general sensuality.

The practical inference suggested by this experience and these observations is, that speech-making, pledge-signing, and blue-ribbon missions can only effect temporary results unless supplemented by satisfying the natural appetite of hungry people by supplies of food that are not only nutritious, but savory and varied. Such food need be no more expensive than that which is commonly eaten by the poorest of Englishmen, but it must be far better cooked.—WILLIAMS *Chemistry of Cookery,* ch. 5, p. 60. (A., 1900.)

141. ALCOHOL WEAKENS VOLITION—*Morbid Physical Craving—Physical Remedies for Drunkenness—Seclusion—Absolute Abstinence.*—It is the physical craving produced by the continued action of the stimulant upon the nutrition of the nervous system which renders the condition of the habitual drunkard one with which it is peculiarly difficult to deal by purely moral means. Vain is it to recall the motives for a better course of conduct to one who is already familiar with them all, but is destitute of the will to act upon them; the seclusion of such persons from the reach of alcoholic liquors, for a sufficient length of time to free the blood from its contamination, to restore the healthful nutrition of the brain, and to enable the recovered mental vigor to be wisely directed, seems to afford the only prospect of reformation; and this cannot be expected to be permanent unless the patient determinately adopts and steadily acts on the resolution to abstain entirely from that which, if again indulged in, will be poison alike to his body and to his mind, and will transmit its pernicious influence to his offspring.—CARPENTER *Mental Physiology,* bk. ii, ch. 17, p. 653. (A., 1900.)

142. ALCOHOL, WHAT IS A HARMLESS DOSE OF?—That for alcohol, as for all other medicinal agents of the same order, there may be a dose the effects of which may pass unperceived—which may not diminish the elasticity of our organs—there can be no doubt. But what is this dose? The determination of it is very difficult; it varies with the individual, with the disposition at

the moment, and with a multitude of indefinable circumstances. It is on the average less than 7½ grams; less, therefore, than the amount of alcohol in half a glass of port, in one-tenth of a liter of *bière d'ale;* very much less, therefore, than the quantity in which alcohol is habitually consumed. As soon as the dose is increased there is abuse, and the occasions for abuse are not wanting. Action appears heavy immediately, and the alcohol leaves traces of its passage in the nervous centers.—BOECK *The Influence of Alcoholic Liquors on Mental Work.* (Translation, *Journal of Inebriety,* Jan., 1901.)

143. ALLEVIATION OF HUMAN MISERY—*Practical Result of Science.*—And thus mankind will have one more admonition that "the people perish for lack of knowledge"; and that the alleviation of the miseries, and the promotion of the welfare of men, must be sought, by those who will not lose their pains, in that diligent, patient, loving study of all the multitudinous aspects of nature, the results of which constitute exact knowledge, or science.—HUXLEY *Lay Sermons,* serm. 15, p. 378. (A., 1895.)

144. ALLIANCE OF SCIENCES—*Astronomy No Longer Isolated—Sciences Merging in Unity of Nature.*—The establishment of the new method of spectrum analysis drew far closer this alliance between celestial and terrestrial science. Indeed, they have come to merge so intimately one into the other that it is no easier to trace their respective boundaries than it is to draw a clear dividing-line between the animal and vegetable kingdoms. Yet up to the middle of the present century astronomy, while maintaining her strict union with mathematics, looked with indifference on the rest of the sciences; it was enough that she possessed the telescope and the calculus. Now the materials for her inductions are supplied by the chemist, the electrician, the inquirer into the most recondite mysteries of light and the molecular constitution of matter. She is concerned with what the geologist, the meteorologist, even the biologist, has to say; she can afford to close her ears to no new truth of the physical order. Her position of lofty isolation has been exchanged for one of community and mutual aid. The astronomer has become, in the highest sense of the term, a physicist, while the physicist is bound to be something of an astronomer.—CLERKE *History of Astronomy,* pt. ii, ch. 1, p. 176. (Bl., 1893.)

145. ALLUREMENT BY IMITATION—*Wingless Mantis Resembles Orchis.*—But the most curious and beautiful case of alluring protection is that of a wingless mantis in India, which is so formed and colored as to resemble a pink orchis or some other fantastic flower. The whole insect is of a bright pink color, the large and oval abdomen looking like the labellum of an orchid. On each side the two posterior legs have immensely dilated and flattened thighs which represent the petals of a flower, while the neck and forelegs imitate the upper sepal and column of an orchid. The insect rests motionless, in this symmetrical attitude, among bright green foliage, being, of course, very conspicuous, but so exactly resembling a flower that butterflies and other insects settle upon it and are instantly captured. It is a living trap, baited in the most alluring manner to catch the unwary flower-haunting insects.—WALLACE *Darwinism,* ch. 8, p. 144. (Hum., 1889.)

146. ALMIGHTY, THE, SUN AN EMBLEM OF—*The Source of All Life on the Earth—Destruction if Sun's Light Withheld—Fiery Death if Sun's Light Intensified.*—The sun is an emblem of the Almighty in being the source whence all that lives upon the earth derives support. Our very existence depends on the beneficent supply of light and heat poured out continually upon the earth by the great central orb of the planetary scheme. Let the sun forget to shine for a single day, and it would be with us even as tho God had forgotten our existence. . . . Myriads of creatures now living on the earth would perish, uncounted millions would suffer fearfully. But let the sun's rays cease to be poured out for four or five days, and every living creature on the earth would be destroyed. Or, on the other hand, even a worse (or at least more sudden and terrible) fate would befall us if an angel of wrath "poured out his vial upon the sun, and power were given unto it to scorch men with fire."—PROCTOR *Expanse of Heaven,* ch. 2, p. 11. (L. G. & Co., 1897.)

147. ALMSHOUSE OF OCEAN—*Ancient Geologic Forms Have Representatives in Deep Sea.*—One of the most striking features connected with the animals of the deep sea is the frequency with which we find there living species which remind us of kinds which in former geologic periods dwelt in the coastal districts of the oceans. It seems that many of these ancient creatures, when they no longer could hold their own against the more highly organized and developed animals which inhabited the favored stations next the shores, shrunk away into the deep water, and in that undesired part of the world found an asylum, where, amid the changeless environment, they have dwelt for ages, unaltered. Thus the vast profounds of the deep have become a sort of almshouse, whereunto antiquated species have retired before the overwhelming pressure which the newer and higher life ever imposes.—SHALER *Sea and Land,* p. 102. (S., 1894.)

148. ALPHABET OF GEOLOGY—*Evidences of the Work of an Ancient Stream.*—On entering it (the gorge of the Via Mala), the first conclusion is that it must be a fissure. This conclusion in my case was

modified as I advanced. Some distance up the gorge I found upon the slopes to my right quantities of rolled stones, evidently rounded by water-action. Still further up, and just before reaching the first bridge which spans the chasm, I found more rolled stones, associated with sand and gravel. Through this mass of detritus, fortunately, a vertical cutting had been made, which exhibited a section showing perfect stratification. There was no agency in the place to roll these stones, and to deposit these alternating layers of sand and pebbles, but the river which now rushes some hundreds of feet below them. At one period of the Via Mala's history the river must have run at this high level. Other evidences of water-action soon revealed themselves.—TYNDALL *Hours of Exercise in the Alps*, ch. 20, p. 220. (A., 1898.) 7,703

149. ALTAR OF STONEHENGE—*A Nameless Ancient Astronomer and His Enduring Memorial—Evidence of Ancient Sun-worship in England.*—The visitor to Salisbury Plain sees around him a lonely waste, utterly barren except for a few recently planted trees, and otherwise as desolate as it could have been when Hengist and Horsa landed in Britain; for its monotony is still unbroken except by the funeral mounds of ancient chiefs, which dot it to its horizon, and contrast strangely with the crowded life and fertile soil which everywhere surround its borders. In the midst of this loneliness rise the rude, enormous monoliths of Stonehenge—circles of gray stones which seem as old as time, and were there, as we now are told, the temple of a people which had already passed away, and whose worship was forgotten when our Saxon forefathers first saw the place.

In the center of the inner circle is a stone which is believed once to have been the altar; while beyond the outmost ring, quite away to the northeast upon the open plain, still stands a solitary stone, set up there evidently with some special object by the same unknown builders. Seen under ordinary circumstances, it is difficult to divine its connection with the others; but we are told that once in each year, upon the morning of the longest day, the level shadow of this distant, isolated stone is projected at sunrise to the very center of the ancient sanctuary, and falls just upon the altar. The primitive man who devised this was both astronomer and priest, for he not only adored the risen god whose first beams brought him light and warmth, but he could mark his place, and tho utterly ignorant of its nature, had evidently learned enough of its motions to embody his simple astronomical knowledge in a record so exact and so enduring that, tho his very memory has gone, common men are still interested in it; for, as I learned when viewing the scene, people are accustomed to come from all the surrounding country and pass in this desolate spot the short night preceding the longest day of the year, to see the shadow touch the altar at the moment of sunrise.—LANGLEY *The New Astronomy*, ch. 1, p. 1. (H. M. & Co., 1896.)

150. ALTRUISM A NECESSITY OF REPRODUCTION—*Only by Maternal Care and Solicitude Do Races Survive—The Vicarious Principle in Nature.*—Sympathy, tenderness, unselfishness, and the long list of virtues which make up altruism, are the direct outcome and essential accompaniment of the reproductive process. Without some rudimentary maternal solicitude for the egg in the humblest forms of life, or for the young among higher forms, the living world would not only suffer, but would cease. For a time in the life-history of every higher animal the direct, personal, gratuitous, unrewarded help of another creature is a condition of existence. Even in the lowliest world of plants the labors of maternity begin, and the animal kingdom closes with the creation of a class in which this function is perfected to its last conceivable expression. The vicarious principle is shot through and through the whole vast web of nature; and if one actor has played a mightier part than another in the drama of the past, it has been self-sacrifice. What more has come into humanity along the line of the struggle for the life of others will be shown later. But it is quite certain that, of all the things that minister to the welfare and good of man, of all that make the world varied and fruitful, of all that make society solid and interesting, of all that make life beautiful and glad and worthy, by far the larger part has reached us through the activities of the struggle for the life of others.—DRUMMOND *Ascent of Man*, p. 18. (J. P., 1900.)

151. AMAZEMENT AT POWER OF MAGNET—*Augustine's Description.*—"When I first saw it," says St. Augustine, speaking of the attraction of the magnet, "I was thunderstruck (*"vehementer inhorrui"*), for I saw an iron ring attracted and suspended by the stone; and then, as if it had communicated its own property to the iron it attracted, and had made it a substance like itself, this ring was put near another and lifted it up, and as the first ring clung to the magnet, so did the second ring to the first. A third and fourth were similarly added, so that there hung from the stone a kind of chain of rings with their hoops connected, not interlinking, but attached together by their outer surface. Who would not be amazed at this virtue of the stone, subsisting, as it does, not only in itself, but transmitted through so many suspended rings and binding them together by invisible links?

"Yet far more astonishing is what I heard about the stone from my brother in the episcopate, Severus, Bishop of Milevis. He told me that Bathanarius, once Count of

Africa, when the bishop was dining with him, produced a magnet, and held it under a silver plate on which he placed a bit of iron; then as he moved his hand, with the magnet underneath the plate, the iron upon the plate moved about accordingly. The intervening silver was not affected at all, but precisely as the magnet was moved backward and forward below it, no matter how quickly, so was the iron attracted above. I have related what I myself have witnessed. I have related what I was told by one whom I trust as I trust my own eyes."—PARK BENJAMIN *Intellectual Rise in Electricity*, ch. 4, p. 87. (J. W., 1898.)

152. AMBIGUITY OF THE WORD "LIGHT"—*Natural Agency vs. Human Impression—The Luminiferous Ether.*—The word "light" may be used in two different senses; it may mean the impression made upon consciousness, or it may mean the physical agent which makes the impression. . . . That agent is a substance which fills all space, and surrounds the atoms and molecules of bodies. To this interstellar and interatomic medium definite mechanical properties are ascribed, and we deal with it in our reasonings and calculations as a body possessed of these properties. In mechanics we have the composition and resolution of forces and of motions, extending to the composition and resolution of vibrations. We treat the luminiferous ether on mechanical principles, and, from the composition, resolution, and interference of its vibrations we deduce all the phenomena displayed by crystals in polarized light.—TYNDALL *Lectures on Light*, lect. 4, p. 128. (A., 1898.)

153. AMBITION OF GREAT ASTRONOMER—*Investigation of All Stars in the Heavens.*—"I resolved," he [Herschel] writes, "to examine every star in the heavens with the utmost attention and a very high power, that I might collect such materials for this research as would enable me to fix my observations upon those that would best answer my end. The subject has already proved so extensive, and still promises so rich a harvest to those who are inclined to be diligent in the pursuit, that I cannot help inviting every lover of astronomy to join with me in observations that must inevitably lead to new discoveries."—CLERKE *History of Astronomy*, ch. 1, p. 15. (Bl., 1893.)

154. AMERICA AN UNSTABLE CONTINENT—*Peril of High Buildings—Northern Europe Stable by Comparison.*—It is clear that we cannot, in this country, reckon on an earth as stable as that of the northern region of Europe, where our race was bred and our building system developed. It is equally clear that the mode of construction should be adapted to the new needs which the less firm ground of this country imposes on us. As long as the building material most commonly in use was timber, and the masonry structures of a low and substantial nature, they were fairly fitted to afford the resistance required to withstand the shocks which could be expected to come upon them. But the combination of ambition and economy which is filling the land with lofty and flimsy structures invites calamity on the least disturbance of the earth. The shock of 1755, which did little more than stir the fears, shake down the chimney-tops of the old town of Boston, and afford a text for many interesting sermons, would be extremely disastrous to the higher and weaker structures of to-day.—SHALER *Aspects of the Earth*, p. 39. (S., 1900.)

155. AMERICA THE OLD WORLD—*First to Rise from the Waste of Waters.*—First-born among the continents, tho so much later in culture and civilization than some of more recent birth, America, so far as her physical history is concerned, has been falsely denominated the New World. Hers was the first dry land lifted out of the waters, hers the first shore washed by the ocean that enveloped all the earth beside; and while Europe was represented only by islands rising here and there above the sea, America already stretched an unbroken line of land from Nova Scotia to the Far West. —AGASSIZ *Geological Sketches*, ser. i. ch. 1, p. 1. (H. M. & Co., 1896.)

156. AMUSEMENTS OF ANIMALS—*Wild Vaulting of Ibis in the Air.*—The black-faced ibis of Patagonia, a bird nearly as large as a turkey, indulges in a curious mad performance, usually in the evening, when feeding-time is over. The birds of a flock, while winging their way to the roosting-place, all at once seem possessed with frenzy, simultaneously dashing downwards with amazing violence, doubling about in the most eccentric manner; and when close to the surface rising again to repeat the action, all the while making the air palpitate for miles around with their hard, metallic cries. Other ibises, also birds of other genera, have similar aerial performances.—HUDSON *Naturalist in La Plata*, ch. 19, p. 265. (C. & H., 1895.)

157. ANALOGY OF NATURAL AND SPIRITUAL—*Poetry a Form of Science.*—How profoundly Hebrew poetry is saturated with this high thought will appear when we try to conceive of it with this left out. True poetry is only science in another form. And long before it was possible for religion to give scientific expression to its greatest truths, men of insight uttered themselves in psalms which could not have been truer to nature had the most modern light controlled the inspiration. "As the hart panteth after the water-brooks, so panteth my soul after Thee, O God!" What fine sense of the analogy of the natural and the spiritual does not underlie these words! As the hart after its environment, so man after his; as the

water-brooks are fitly designed to meet the natural wants, so fitly does God implement the spiritual need of man. It will be noticed that in the Hebrew poets the longing for God never strikes one as morbid, or unnatural to the men who uttered it. It is as natural to them to long for God as for the swallow to seek her nest. Throughout all their images no suspicion rises within us that they are exaggerating. We feel how truly they are reading themselves, their deepest selves. No false note occurs in all their aspiration.—DRUMMOND *Natural Law in the Spiritual World*, p. 245. (H. Al.)

158. ANALOGY OF VEGETATION OF OLD AND NEW WORLDS—*Unity of Nature.*—Amid the colossal and majestic forms of an exotic flora we feel how wonderfully the flexibility of our nature fits us to receive new impressions, linked together by a certain secret analogy. We so readily perceive the affinity existing among all the forms of organic life that, altho the sight of a vegetation similar to that of our native country might at first be most welcome to the eye, as the sweet familiar sounds of our mother tongue are to the ear, we nevertheless, by degrees, and almost imperceptibly, became familiarized with a new home and a new climate. As a true citizen of the world, man everywhere habituates himself to that which surrounds him; yet fearful, as it were, of breaking the links of association that bind him to the home of his childhood, the colonist applies to some few plants in a far-distant clime the names he had been familiar with in his native land; and by the mysterious relations existing among all types of organization, the forms of exotic vegetation present themselves to his mind as nobler and more perfect developments of those he had loved in earlier days. Thus do the spontaneous impressions of the untutored mind lead, like the laborious deductions of cultivated intellect, to the same intimate persuasion that one sole and indissoluble chain binds together all nature.—HUMBOLDT *Cosmos*, vol. i, int., p. 27. (H., 1897.)

159. ANALYSIS A COMPLEX PROBLEM—*An Expert Alone Can Secure Needed Data—Must Know "Gathering-ground" of Water.*—Accompanying the sample [of water] should be a more or less full statement of its source. There can be no doubt that, in addition to a chemical and bacteriological report of a water, there should also be made a careful examination of its source. This may appear to take the bacteriologist far afield, and in point of fact, as regards distance, this may be so. But until he has seen for himself what "the gathering-ground" is like, and from what sources come the feeding streams, he cannot judge the water as fairly as he should be able to do. The configuration of the gathering-ground, its subsoil, its geology, its rainfall, its relation to the slopes which it drains, the nature of its surface, the course of its feeders, and the absence or presence of cultivated areas, of roads, of houses, of farms, of human traffic, of cattle and sheep—all these points must be noted, and their influence, direct or indirect, upon the water carefully borne in mind.—NEWMAN *Bacteria*, ch. 2, p. 38. (G. P. P., 1899.)

160. ANATOMY AMONG SAVAGES—*Comparative Study of the Toes of the Ostrich.*—The science of homologies, as developed by Cuvier and Hunter and Owen and Huxley, is indeed an intricate, almost a transcendental, science. Yet Dr. Livingstone found the natives of Africa debating a question which belongs essentially to that science and involves the whole principle of the mental process by which it is pursued. The debate was on the question "whether the two toes of the ostrich represent the thumb and forefinger in man, or the little and ring-finger." This is purely a question of comparative anatomy. It is founded on the instinctive perception that even between two frames so widely separated as those of an ostrich and a man there is a common plan of structure, with reference to which plan parts wholly dissimilar in appearance and in use can nevertheless be identified as "representative" of each other—that is, as holding the same relative place in one ideal order of arrangement.—ARGYLL *Reign of Law*, ch. 4, p. 118. (Burt.)

161. ———— ———— *Practical Knowledge of.*—A moment's reflection will show that all savages had a practical knowledge of anatomy. They knew where to strike with the club to paralyze the brain, to slash with the cutlass for the shallow arteries, to pierce with the spear to reach the fountain of life.—MASON *Origins of Invention*, ch. 8, p. 267. (S., 1899.)

162. ANATOMY, COMPARATIVE GIVES FULLER KNOWLEDGE OF MAN—*Likeness and Unlikeness of Lower Animals to Man.*—Comparative anatomy and physiology, by treating the human species as one member of a long series of related organisms, have gained a higher and more perfect understanding of man himself and his place in the universe than could have been gained by the narrower investigation of his species by and for itself. . . . No doubt the phenomena of intellect appear in vastly higher and more complete organization in man than in beings below him in the scale of nature, that beasts and birds only attain to language in its lower rudiments, and that only the germs of moral tendency and social law are discernible among the lower animals. Yet tho the mental and moral interval between man and the nearest animals may be vast, the break is not absolute, and the investigation of the laws of reason and instinct throughout the zoological system, which is already casting some scattered rays of light on the study of man's highest

organization, may be destined henceforth to throw brighter illumination into its very recesses.—DANIEL WILSON *Anthropology*, ch. 1, p. 1. (Hum., 1885.)

163. ANIMALS, ARCTIC—*Commonly White—The Tree-frequenting Sable Is Brown—Raven Needs No Protective Color.*—Whenever we find arctic animals which, from whatever cause, do not require protection by the white color, then neither the cold nor the snow-glare has any effect upon their coloration. The sable retains its rich brown fur throughout the Siberian winter; but it frequents trees at that season and not only feeds partially on fruits or seeds, but is able to catch birds among the branches of the fir-trees, with the bark of which its color assimilates. Then we have that thoroughly arctic animal, the musk-sheep, which is brown and conspicuous; but this animal is gregarious, and its safety depends upon its association in small herds. It is therefore of more importance for it to be able to recognize its kind at a distance than to be concealed from its enemies. . . . The common raven, a true arctic bird, . . . always retains its black coat. . . . The raven is a powerful bird and fears no enemy, while, being a carrion-feeder, it has no need for concealment in order to approach its prey.—WALLACE *Darwinism*, ch. 8, p. 130. (Hum.)

164. — ——— *Once Dwelt in Southern Europe—A Colder Climate in Geologic Times—Reindeer at Foot of Pyrenees.*—The northernmost part of Norway and Sweden is at this day the southern limit of the reindeer in Europe, but their fossil remains are found in large quantities in the drift about the neighborhood of Paris, and quite recently they have been traced even to the foot of the Pyrenees, where their presence would, of course, indicate a climate similar to the one now prevailing in northern Scandinavia. Side by side with the remains of the reindeer are found those of the European marmot, whose present home is in the mountains, about six thousand feet above the level of the sea. The occurrence of these animals in the superficial deposits of the plains of central Europe, one of which is now confined to the high north, and the other to mountain-heights, certainly indicates an entire change of climatic conditions since the time of their existence.—AGASSIZ *Geological Sketches*, ser. i, ch. 8, p. 210. (H. M. & Co., 1896.)

165. ANIMALS AS DISTRIBUTERS OF SEEDS—*Hooks and Spines for Seed-dispersal.*—An idea of the important part played by these various hooks and spines in the dissemination of seeds may be gained by reading the following paragraph written by the German botanist Kerner:

"About ten per cent. of all the flowering plants possess fruits and seeds which are dispersed by means of clawed or barbed processes. The part of the plant which is provided with these structures hooks on to the hairs, bristles, or feathers of any bird or other animal that happens to come into contact with it. The consequence is that it is torn away and carried off by the animal. This act of depredation is, of course, not intentional on the part of the creature that performs it; on the contrary, such appendages are a source of discomfort, and are got rid of as soon as possible. But in many cases this is not accomplished until a considerable distance has been traversed.—WEED *Seed-travelers*, pt. iii, p. 51. (G. & Co., 1899.)

166. ANIMALS, EXISTENCE OF, DEPENDENT ON PLANTS—*The Plant the Mediator between Animal and Mineral.*—The very existence of animal life, to take another case of broad economy, is possible only through the mediation of the plant. No animal has the power to satisfy one single impulse of hunger without the cooperation of the vegetable world. It is one of the mysteries of organic chemistry that the chlorophyll contained in the green parts of plants, alone among substances, has the power to break up the mineral kingdom and utilize the products as food. Tho detected recently in the tissues of two of the very lowest animals, chlorophyll is the peculiar possession of the vegetable kingdom, and forms the solitary point of contact between man and all higher animals and their supply of food. Every grain of matter, therefore, eaten by man, every movement of the body, every stroke of work done by muscle or brain, depends upon the contribution of a plant, or of an animal which has eaten a plant.—DRUMMOND *Ascent of Man*, p. 240. (J. P., 1900.)

167. ANIMALS FIXED TO THE EARTH LIKE PLANTS—*Sponges Rooted to the Sea-floor.*—[There is one division that consists of] animals that remain perfectly fixed to the bottom or are capable only of creeping or crawling over the rocks and sand, such as the sponges, hydroids, sedentary tunicates, gasteropods, most lamellibranchs, and many crustacea. This portion of the fauna [of the sea] has been called the benthos.—HICKSON *Fauna of the Deep Sea*, ch. 3, p. 53. (A., 1894.)

168. ANIMALS GIVE WARNING OF EARTHQUAKE—*Alarm of Dogs, Cats, and Horses—Sea-birds Flying Inland.*—A study of the warnings furnished by animals is also interesting. It is said that several of the natives in Caracas possess oracular quadrupeds, such as dogs, cats, and jerboas, which anticipate coming dangers by their restlessness. Before the catastrophe of 1812, at Caracas, a Spanish stallion broke out from its stable and escaped to the highlands, which was regarded as the result of the prescience of a coming calamity. Before the disturbances of 1822 and 1835, which

shook Chile, immense flocks of sea-birds flew inland, as if they had been alarmed by the commencement of some suboceanic disturbance. Before this last shock it is also related that all the dogs escaped from the city of Talcahuano.—MILNE *Earthquakes*, ch. 18, p. 307. (A., 1899.)

169. ANIMALS, LIMITED INTELLIGENCE OF—*Inability To Learn by Experience—Mingled Folly and Wisdom of Serpent.*—Fabre states (*Souvenirs Entomologiques*, pp. 168-177) that a sphex—an insect belonging to the same highly endowed order with ants—stocks its nest with paralyzed grasshoppers, which are invariably dragged into the burrow by their antennæ. When these were cut off close to the head, the sphex seized the palpi; but when these were likewise cut off, the attempt to drag its prey into the burrow was given up in despair. The sphex had not intelligence enough to seize one of the six legs or the ovipositor of the grasshopper, which, as M. Fabre remarks, would have served equally well. So again, if the paralyzed prey with an egg attached to it be taken out of the cell, the sphex, after entering and finding the cell empty, nevertheless closes it up in the usual elaborate manner. Bees will try to escape and go on buzzing for hours on a window, one-half of which has been left open. Even a pike continued during three months to dash and bruise itself against the glass sides of an aquarium, in the vain attempt to seize minnows on the opposite side. A cobra-snake was seen by Mr. Larard to act much more wisely than either the pike or the sphex; it had swallowed a toad lying within a hole, and could not withdraw its head; the toad was disgorged, and began to crawl away; it was again swallowed and again disgorged; and now the snake had learned by experience, for it seized the toad by one of its legs and drew it out of the hole. The instincts of even the higher animals are often followed in a senseless or purposeless manner: the weaver-bird will perseveringly wind threads through the bars of its cage, as if building a nest; a squirrel will pat nuts on a wooden floor, as if he had just buried them in the ground; a beaver will cut up logs of wood and drag them about, tho there is no water to dam up; and so in many other cases.—DARWIN *Formation of Vegetable Mold*, ch. 2, p. 26. (Hum., 1887.)

170. ANIMALS MAKE CLEARING AROUND THEIR HOMES—*A Resource for Pastime and Protection.*—He [the viscacha] lives in a small community of twenty or thirty members, in a village of deep-chambered burrows, all with their pit-like entrances closely grouped together; and as the village endures forever, or for an indefinite time, the earth constantly being brought up forms a mound thirty or forty feet in diameter; and this protects the habitation from floods on low or level ground. Again, he is not swift of foot, and all rapacious beasts are his enemies; he also loves to feed on tender succulent herbs and grasses, to seek for which he would have to go far afield among the giant grass, where his watchful foes are lying in wait to seize him; he saves himself from this danger by making a clearing all round his abode, on which a smooth turf is formed; and here the animals feed and have their evening pastimes in comparative security: for when an enemy approaches, he is easily seen; the note of alarm is sounded, and the whole company scuttles away to their refuge.—HUDSON *Naturalist in La Plata*, ch. 1, p. 10. (C. & H., 1895.)

171. ——— ——— *Enemies Cannot Approach Unseen—Open Space for Playground.*—The strongest instinct of this animal [the viscacha] is to clear the ground thoroughly about its burrows; and it is this destructive habit that makes it necessary for cultivators of the soil to destroy all the viscachas in or near their fields. On the uninhabited pampas, where the long grasses grow, I have often admired the viscachera; for it is there the center of a clean space, often of half an acre in extent, on which there is an even, close-shaven turf; this clearing is surrounded by the usual rough growth of herbs and giant grasses. In such situations this habit of clearing the ground is eminently advantageous to them, as it affords them a comparatively safe spot to feed and disport themselves on, and over which they can fly to their burrows without meeting any obstruction on the slightest alarm.—HUDSON *Naturalist in La Plata*, ch. 20, p. 303. (C. & H., 1895.)

172. ANIMALS, MARINE, THEIR MODES OF LIFE—Now, amongst marine animals we can recognize three principal modes of life. Some animals simply float or drift about with the currents of the sea and are unable to determine for themselves, excepting, perhaps, within very small limits, the direction in which they travel. Such are the countless forms of protozoa, the jellyfishes and medusæ, numerous pelagic worms and crustacea, . . . and many other forms well known to those who are in the habit of using the tow-net.—HICKSON *Fauna of the Deep Sea*, ch. 3, p. 52. (A., 1894.)

173. ANIMALS NOT AUTOMATA—*Protozoa Show Voluntary Movement.*—There is not the slightest confirmation to be found for the assertion that the lower animals, and children in the early days of life, are merely reflex machines, which make certain movements with mechanical certainty as soon as we press the spring. Even such of the protozoa as undoubtedly belong to the animal kingdom give plain evidence of voluntary movement. The chick just out of the shell executes movements which are in great part at least of the nature of vol-

untary actions. No one will, of course, deny that reflex movements may also be observed from the first, especially among the more complexly organized animals. It must not, however, be forgotten that these purposive reflexes have become possible through an organization acquired in the course of countless generations.—WUNDT *Psychology*, lect. 15, p. 226. (Son. & Co., 1896.)

174. ANIMALS NOT UNDERSTOOD WITHOUT STUDY OF ENVIRONMENT— The fact is, no animal can be correctly appreciated by us if we do not well understand the circumstances of its being, its surrounding conditions. Each creature's structure is an expression and manifestation of that interplay of influences and activities between its own being and its environment, which constitutes its life.—MIVART *Types of Animal Life*, ch. 9, p. 248. (L. B. & Co., 1893.)

175. ANIMALS OF ANCIENT EGYPT SAME AS MODERN—*Five Thousand Years Have Made No Change.*—Our domestic animals have always followed man in the progress of civilization. Wherever the traces of civilization are found, there are found also traces of the presence of animals not only domesticated, but also wild. No civilization has left us more interesting traces in this respect than that of Egypt; on the Egyptian monuments are represented in sculptures and drawings, and in the catacombs are preserved in the shape of mummies, animals which lived many thousand years ago. Some of those relics, which have come down to us, are unquestionably nearly five thousand years old. They form a very interesting basis by which to ascertain to what extent animals may change under the different circumstances in which they live. The most careful comparison which has been made between the skeletons of the animals preserved in mummies, and those recently killed in the valley of the Nile, has not shown the slightest difference between them.—AGASSIZ *Structure of Animal Life*, lect. 3, p. 48. (S., 1886.)

176. ANIMALS, PERFECTION OF— *Enforced by the Death Penalty—Nothing That Lives Can Be Wholly a Failure—All in the Long Run Advancing—Natural Selection.*—By placing the death penalty upon the slightest shortcoming, natural selection so discourages imperfection as practically to eliminate it from the world. The fact that any given animal is alive at all is almost a token of its perfectness. Nothing living can be wholly a failure; for the moment that it fails, it ceases to live. Something more fit, were it even by a hairbreadth, secures its place; so that all existing lives must, with reference to their environment, be the best possible lives. Natural selection is the means employed in nature to bring about perfect health, perfect wholeness, perfect adaptation, and in the long run the ascent of all living things.—DRUMMOND *Ascent of Man*, p. 208. (J. P., 1900.)

177. ANIMALS, PRIMEVAL, DID NOT NEED MOTHERS—*Not Children, but Mere Offspring—The Early World Bleak and Loveless.*—The truth is, Nature so made animals in the early days that they did not need mothers. The moment they were born they looked after themselves, and were perfectly able to look after themselves. Mothers in these days would have been a superfluity. All that Nature worked at at that dawning date was maternity in a physical sense—motherhood came as a later and a rarer growth. The children of those days were not really children at all; they were only offspring, springers off, deserters from home. At one bound they were out into life on their own account, and she who begat them knew them no more. That early world, therefore, for millions and millions of years was a bleak and loveless world. It was a world without children and a world without mothers. It is good to realize how heartless Nature was till these arrived.—DRUMMOND *Ascent of Man*, p. 270. (J. P., 1900.)

178. ANIMALS, PROTECTION OF, BY NON-CONDUCTING CLOTHING—*Utility of Woolen Garments.*—It is the imperfect conductivity of woolen textures which renders them so eminently fit for clothing. They preserve the body from sudden accessions and from sudden losses of heat. The same quality of non-conductivity manifests itself when we wrap flannel round a block of ice. The ice thus preserved is not easily melted. In the case of the human body, on a cold day, the woolen clothing prevents the transmission of motion from within outwards. In the case of the ice, on a warm day, the selfsame fabric prevents the transmission of motion from without inwards. Animals which inhabit cold climates are furnished by nature with their necessary clothing. Birds especially need this protection, for they are still more warm-blooded than the mammalia. They are furnished with feathers, and between the feathers the interstices are filled with down, the molecular constitution and mechanical texture of which render it, perhaps, the worst of all conductors. Here we have another example of that harmonious relation of life to the conditions of life which is incessantly presented to the student of natural science. —TYNDALL *Heat a Mode of Motion*, lect. 9, p. 256. (A., 1900.)

179. ANIMALS, SURRENDER OF, TO MAN—*Submission of Dog, Sheep, and Goat, Llama, Camel, Horse, Ass, Elephant, and Cow.*—By and by they turned the artillery of nature on herself. The dog raised a flag of truce and came in to join the hosts of man against the rest. The mountain-sheep and the wild goat descended from their rocky fortresses, gave up the contest, and surrendered skins and fleece and flesh and milk

to clothe and feed the inventor of the fatal arrow.

Tired of deadly weapons and decoys and snares and pitfalls set by the most cunning of enemies too long ago for any historian, the llama, the camel, the horse, the ass, the elephant, the cow entered into a solemn and everlasting treaty to lend their agile feet, their patient backs and necks and shoulders, their milk, their flesh, their hides, their hair, their very bones, to minister to men's wants. How well this treaty has been observed on both sides let all domestic creatures bear witness. Those that refused to enter in any way into these stipulations are doomed sooner or later to extinction, and many species have already disappeared or withdrawn to the waste places of the earth in despair.—Mason *Origins of Invention*, ch. 8, p. 259. (S., 1899.)

180. ANIMALS TRANSPORTING SEEDS—*The Bur-marigold—The "Sticktights"—Man Limits the Processes of Nature.*—Look at one of these seeds [of the bur-marigold] through a simple lens, and study its structure. See the four ribs extending up and down along the sides, and notice particularly the sharp-pointed hooks curving backward toward the base. See how these ribs project up beyond the seed, as spines provided with recurved barbs.

In pulling the seed-head to pieces, some of these seeds are likely to adhere to the fingers by means of these barbs, while if you touch them to a piece of cloth they *will "stick tight"*—a fact which has given them this term for a common name. It is easy to see how this sort of an adaptation would be useful to the plant in getting its seed dispersed. Instead of calling upon the wind to waft its seeds far and wide, it makes the beasts of the field its burden-bearers. These "stick-tights" will take firm hold upon the hair or fur of almost any of the larger animals, many of which under the conditions existing in previous ages of the world, when our plants were developing, roamed about in just the situations where the bur-marigold is most at home. So, also, they do to-day, tho mankind has interfered in the older settled regions to render communication by such animals between regions far apart more difficult than formerly.—Weed *Seed-travelers*, pt. iii, p. 45. (G. & Co., 1899.)

181. ANIMALS WITHOUT INFANCY—*Parent and Child Never Know Each Other.*—This abnormal form [the *talegallus*—the best known brush-turkey] buries its eggs in the huge mound made by the male, and troubles herself no more about them. When the young is fully developed it simply kicks the coffin to pieces in which its mother interred it, and, burrowing its way up to the sunshine, enters on the pleasures and pains of an independent existence from earliest infancy—that is, if a species born into the world in full possession of all the wisdom of the ancients can be said ever to know infancy.—Hudson *Naturalist in La Plata*, ch. 5, p. 87. (C. & H., 1895.)

182. ANOMALIES OF SCIENCE—*Explanation of Discrepancies Will Reveal New Laws.*—The man of science, like the man of law, has brought before him many an anomaly; but, unlike the judge or the advocate, he knows that the contradictions he studies are only such in seeming; he feels confident that nature at the core is in agreement with herself. Any day, he believes, these apparent contradictions may be resolved into cases of detected law, not simple enough to disclose itself to aught but the most rigorous analysis. In the realm of heat it seems that certain rules of radiation, conduction, boiling-points, and the like, are general, not universal. In most cases they act as if alone; in a few cases their effect is masked by causes as yet not understood. Let a few cases as perplexing as that of the alloys under refrigeration be recounted: Common solder has a lower melting-point than any of its ingredients. Sulfur fuses at 120° C., and thickens again at 220° C. When steel is heated and dipped into cold water it is hardened; the same treatment softens copper. While almost every substance expands with heat, rubber shrinks. In most cases electrical conductivity is impaired by increase of temperature, yet a carbon pencil rises to an almost threefold augmentation of conductivity when brought to incandescence in an electric lamp. We may be well assured that when these anomalies are resolved the explanations will bear in their train other difficulties for research yet more subtile. Science never does worthier work than where, as here, she points to her own unfinished walls, and bids the student as a privilege and a duty to supply their gaps as best he may.—Iles *Flame, Electricity, and the Camera*, ch. 6, p. 76. (D. & McC., 1900.)

183. ANTAGONISMS OF BACTERIA—*Environment That Is Favorable to Some, Destructive of Others.*—Study of the life-history of many of the water bacteria will reveal the fact that they can live and multiply under conditions which would at once prove fatal to other species. Some of these water organisms can indeed increase and multiply in distilled water, whereas it is known that other species cannot even live in distilled water, owing to the lack of pabulum. Thus we see that what is favorable for one species may be the reverse for another.—Newman *Bacteria*, ch. 1, p. 33. (G. P. P., 1899.)

184. ANTHROPOMORPHISM A MISNOMER—*Likeness of Soul, Not of Form.*—The word [anthropomorphism] is in itself a misrepresentation of the fundamental idea which it is employed to designate, and against which it is intended to raise a prejudice. Anthropomorphism means literally

man-formism, conveying the idea that it is, in some sense or other, the human "form" that is ascribed to the agencies which are at work in nature. But this suggestion is altogether at variance with the truth. It is not the form of man that is in question. It is the mind and spirit of man—his reason, his intelligence, and his will. Nor is it even these under all the conditions, or under any of the limitations, with which they are associated in us. But the question is of a real and fundamental analogy, despite all differences of form or of limiting conditions, between the mind which is in us and the mind which is in nature. The true etymological expression for this idea, if we are to have any word constructed on the same model out of Greek, would be. not anthropomorphism, but anthropopsychism, which means not man-formism, but man-soulism. The use of the word in this construction would raise much more truly the real issue.—ARGYLL *Unity of Nature*, ch. 5, p. 99. (Burt.)

185. ANTHROPOMORPHISM AN IDLE BUGBEAR—*All Knowledge Is Anthropomorphic—Man Can Think Only as Man.*—There is indeed one objection to this [teleological] method of conception, which would be a fatal objection if it could be consistently maintained. But all the strength of this objection lies in the obscure terrors which a very long word is sometimes capable of inspiring. This word is "anthropomorphism." Purpose and design, it is said, is a human conception. Unquestionably it is, and so is all knowledge in every form. We can never stand outside ourselves. We can never get behind or above our own methods of conception. The human mind can know nothing and can think of nothing except in terms of its own capacities of thought.—ARGYLL *Reign of Law*, ch. 2, p. 63. (Burt.)

186. ANTHROPOMORPHISM INVERTED—Just as the theologians tell us—and logically enough—that if there is a divine mind, the best, and indeed only, conception we can form of it is that which is formed on the analogy, however imperfect, supplied by the human mind; so with "inverted anthropomorphism" we must apply a similar consideration with a similar conclusion to the animal mind. The mental states of an insect may be widely different from those of a man, and yet most probably the nearest conception that we can form of their true nature is that which we form by assimilating them to the pattern of the only mental states with which we are actually acquainted.—ROMANES *Animal Intelligence*, int., p. 10. (A., 1899.)

187. ANTICIPATIONS OF MODERN METHODS—*Granaries, Original, of Primitive Peoples.*—The thousand and one manipulations at the hands of women formerly practised on vegetal substances preparatory to consumption were all anticipatory of methods now in operation on a grander scale. They were the predecessors of harvesters, wagons and freight trains, granaries and elevators, mills and bakeries. The little wicker basket, holding about a barrel, set up in some northern California hut to preserve acorns, the larger granaries in the Mojave country, the pretty structures conspicuous in the pictures of African villages, are all familiar now on the farm and in the great grain elevators.—MASON *Woman's Share in Primitive Culture*, ch. 2, p. 17. (A., 1894.)

188. ANTICS OF THE SCISSORS-TAIL—*Fun-loving Birds.*—The performance of the scissors-tail, a tyrant-bird, is remarkable. This species is gray and white, with black head and tail and a crocus-yellow crest. On the wing it looks like a large swallow, but with the two outer tail-feathers a foot long. The scissors-tails always live in pairs, but at sunset several pairs assemble, the birds calling excitedly to each other; they then mount upwards, like rockets, to a great height in the air, and, after wheeling about for a few moments, precipitate themselves downwards with amazing violence in a wild zigzag, opening and shutting the long tail-feathers like a pair of shears, and producing loud whirring sounds, as of clocks being wound rapidly up, with a slight pause after each turn of the key. This aerial dance over, they alight in separate couples on the tree-tops, each couple joining in a kind of duet of rapidly repeated, castanet-like sounds.—HUDSON *Naturalist in La Plata*, ch. 19, p. 271. (C. & H., 1895.)

189. ANTIQUITY NOT BARBARISM—The remarkable phase of archaic culture known as Mycenæan [since its remains were first recognized at the ancient Greek city of Mycenæ]—when arms of bronze were beautifully inlaid with gold, when gems were cut, and the potter's art had attained a high degree of perfection—appears to have attained its zenith about 1500 B. C. It must therefore have commenced much earlier.—AVEBURY *Prehistoric Times*, ch. 1, p. 8. (A., 1900.)

190. ANTIQUITY OF ANIMAL ARCHITECTURE—*Beaver-dam a Thousand Years Old—A Geological Survival.*—In one case Prof. Agassiz obtained what may be termed geological evidence of the truth of an opinion advanced by Mr. Morgan, that beaver-works may be hundreds if not thousands of years in course of continuous formation. For the purpose of obtaining a secure foundation for a mill-dam erected above a beaver-dam, it was necessary to clear away the soil from the bottom of the beaver-pond. This soil was found to be a peat-bog. A trench was dug into the peat 12 feet wide by 1,200 feet long, and 9 feet deep: all the way along this trench old stumps of trees were found at various depths, some still

bearing marks of having been gnawed by beavers' teeth. Agassiz calculated the growth of the bog as about a foot per century, so that here we have tolerably accurate evidence of an existing beaver-dam being somewhere about a thousand years old. —ROMANES *Animal Intelligence*, ch. 12, p. 384. (A., 1899.)

191. ANTIQUITY OF ASTRONOMY—*The Most Ancient of the Sciences—Primitive Observations—Egyptian Calendar—Chinese Calendar—The Week Instituted 4,000 Years Ago—Ancient Record of Solar Eclipse.*—Astronomy is the most ancient of the sciences. Even before the invention of writing and the beginning of history men examined the sky and laid the foundations of a primeval almanac. The primitive observations have been lost in the revolutions of nations; we possess, however, some fairly good records, considering their antiquity, among others those of the Egyptians and Chinese made in the thirtieth century before our era, stating that at the vernal equinox the sun was situated in the constellation Taurus, then the first sign of the Zodiac; that of an eclipse of the sun made in Egypt in the year 2720 B. C.; that of a conjunction of the planets in Capricorn, made by the Chinese astronomers in the year 2449 B. C.; that of a star in the constellation Hydra made in the year 2306 B. C. The Egyptian calendar was instituted about the year 2782 B. C., and the Chinese calendar about the year 2637 B. C. At least four thousand years have elapsed since our week of seven days was formed in the plains of Babylon, and for several thousand years also each day has taken the name of one of the moving stars known to the ancients: the Sun, the Moon, Mars, Mercury, Jupiter, Venus, and Saturn.—FLAMMARION *Popular Astronomy*, bk. i, ch. 1, p. 5. (A.)

192. ANTIQUITY OF CHINESE HISTORY IN DOUBT—*Chinese Invention of Compass a Question.*—While the beginning of Chinese history is placed by De Lacouperie at the twenty-third century B. C., other Chinese annalists regard it as impossible to rely upon any records dating back more than 800 years before our era. Legge fixes the beginning of trustworthy chronology at 826 B. C., and Plath at 841 B. C. It is apparent, therefore, that in dealing with the legends and traditions which form the basis for the assertion of knowledge of the magnet by the Chinese at very ancient epochs, the doubt whether they properly belong to mythology or to history is unavoidable.—PARK BENJAMIN *Intellectual Rise in Electricity*, ch. 3, p. 66. (J. W., 1898.)

193. ANTIQUITY OF LIFE ON EARTH—*Not Eternal—Geology Proves a Definite Beginning (Gen. i, 1).*—The unstratified rocks are the oldest. They contain no traces of the remains of either animals or plants, and therefore furnish evidence that there was a time when the earth was not inhabited; for there are hardly any animals so soft that none of their parts could be preserved. The solid parts of animals, when once deposited in sand or mud and covered, are there preserved and treasured up for all future time in the solid rock that is formed out of the deposit. In exploring the strata of our earth and examining their contents, geologists have become acquainted with the various animals and plants that have inhabited our globe in the early periods; and their number is so great that the conclusion is inevitable that at all times, since the stratified rocks have been forming, the earth has teemed with inhabitants as various and diversified as they are now. Within the limits of this State there are beds of rock so full of remains of animals and plants that the mass of strata consists of almost nothing else. Indeed, along our seashores we do not find such quantities of dead shells as we find in some of the limestone rocks in the western part of the State of New York. And yet these rocks are among the oldest of the stratified beds on the surface of the earth. But below these are found masses of rock in which no trace of organic remains are found.—AGASSIZ *Structure of Animal Life*, lect. 4, p. 79. (S., 1883.)

194. ANTIQUITY OF MACHINES—*Bow-drill Used by Egyptians—Indians Obtain Fire by Same Means.*—The Dakotas used a drill-bow for the purpose of obtaining fire. This instrument is a small stiff bow, the string of which forms a loop round the upright stick, and thus, when the bow is moved backwards and forwards, gives it a rotatory movement. . . . The use of the bow-drill is very ancient. Ulysses used one to put out the eye of the unfortunate Cyclops. I myself, he says, twirled it round, while my companions pulled the "thong," and it requires no great stretch of the imagination to see the strap drill working until "the very roots of the eye hissed in the fire." The bow-drill was used still earlier by the Egyptians—even in the fourth dynasty.—AVEBURY *Prehistoric Times*, ch. 14, p. 500. (A., 1900.)

195. ANTIQUITY OF MAN—*Change in Estimate of—Archeology, Geology, and Culture Attest Remote Origin of the Human Race.*—It was until of late years commonly held among the educated classes that man's first appearance on earth might be treated on a historical basis as matter of record. It is true that the schemes drawn up by chronologists differed widely, as was naturally the case, considering the variety and inconsistency of their documentary data. On the whole, the scheme of Archbishop Usher, who computed that the earth and man were created in 4004 B. C., was the most popular. It is no longer neces-

sary, however, to discuss these chronologies. inasmuch as new evidence has so changed the aspect of the subject that the quasi-historical schemes of the last century would now hardly be maintained by any competent authority of any school. Geology, notwithstanding the imperfection of its results, has made it manifest that our earth must have been the seat of vegetable and animal life for an immense period of time; while the first appearance of man, tho comparatively recent, is positively so remote that an estimate between twenty and a hundred thousand years may fairly be taken as a minimum. This geological claim for a vast antiquity of the human race is supported by the similar claims of prehistoric archeology and the science of culture, the evidence of all three departments of inquiry being intimately connected and in perfect harmony.—Daniel Wilson *Anthropology*, ch. 5, p. 17. (Hum., 1885.)

196. ANTIQUITY OF POTTERY—*Homer's Mention*.—In the very earliest graves and camp-sites no fragments of pottery occur. If our first parents were makers thereof, we should know it, because this most brittle of human works is also among the most enduring. Fire-making devices were invented before pottery, because all of it was effected by means of fire, if we except sun-dried bricks and lamp-stoves. The bow and the arrow, the spear and the fish-hook, are older. They are found in older graves. Can it be that this art came in with the grinding of food? At any rate, it long antedated Homer, for the potter's wheel is mentioned by him (Il. xviii. 600). The simpler hand epoch antedates all books and writings, and there are many, many tribes of uncivilized peoples on the earth making beautiful ware who do not read at all. The lake-dwellers had pottery, and so had the mound-builders, and the people of very ancient Troy. In Peru beautiful specimens come from the oldest graves, and over the cañons of Colorado, and especially of its tributaries, hundreds of complete vessels, and millions of fragments, are scattered similar to that made near-by to-day.—Mason *Origins of Invention*, ch. 5, p. 154. (S., 1899.)

197. ANTIQUITY OF SEVEN-DAY WEEK—*Not Used by Greeks and Romans*.—Whichever of the three processes may have been used, the interesting point for us to know is that the division of time by periods of seven days is of the highest antiquity and due to the phases of the moon, but that it has not been in use among all nations, for the Greeks and Romans did not make use of it, the first having weeks of ten days (decades), and the second counting by kalends, ides, and nones. But it came into almost general use about the first century of our era.—Flammarion *Popular Astronomy*, bk. ii. ch. 2, p. 103. (A.)

198. ANTIQUITY OF SUN-WORSHIP—Every scholar knows, tho *littérateurs* and men of the world do not, that in the full vigor of the Greek religion the Sun and Moon, not a god and goddess thereof, were sacrificed to as deities—older deities than Zeus and his descendants, belonging to the earlier dynasty of the Titans (which was the mythical version of the fact that their worship was older)—and these deities had a distinct set of fables or legends connected with them.—Mill *Positive Philosophy of Auguste Comte*, p. 20. (H. H. & Co., 1887.)

199. ANTIQUITY OF THE ARCH—*Found in Tombs of Egypt—Neglect of, by Greeks—Skilful Use of, by Romans*.—In the tombs of ancient Egypt real arches are to be seen, constructed in mud-bricks, or later in stone, by architects who quite understood the principle. Yet tho the arch was known in what we call ancient times, it was not at once accepted by the world. It is remarkable that the Greek architects of the classic period never took to it. It was left to the Romans, who applied it with admirable skill, and from whose vaulted roofs, bridges, and domes those of the medieval and modern world are derived.—Tylor *Anthropology*, ch. 10, p. 235. (A., 1899.)

200. ANTIQUITY OF WEAVING—The textile art is older than the human species. For not only spiders and many caterpillars drew out extremely fine threads, but birds wove nests long before man's advent on earth. And, most significant of all, in tropical lands especially, trees and plants fabricated cloth, which men have worn from time immemorial, and on it they have also preserved their thoughts. There is no reason to doubt that the very first women were weavers of a crude kind, and that the textile art has been with us always in one form or another.—Mason *Origins of Invention*, ch. 7, p. 224. (S., 1899.)

201. ANTIQUITY, REMOTE, OF MOUND-BUILDERS—Where it [an ancient mound] is most distinct, it is from fifteen to twenty feet wide, by three or four in height. The area thus enclosed is about one hundred and forty acres, and the wall is two miles and a quarter in length. The stones themselves vary much in size, and Messrs. Squier and Davis suggest that the wall may originally have been about eight feet high, with an equal base. At present trees of the largest size are growing upon it. On a similar work known as "Fort Hill," Highland County, Ohio, Messrs. Squier and Davis found a splendid chestnut tree, which they suppose to be six hundred years old. "If," they say, "to this we add the probable period intervening from the time of the building of this work to its abandonment, and the subsequent period up to its invasion by the forest, we are led

irresistibly to the conclusion that it has an antiquity of at least one thousand years. But when we notice, all around us, the crumbling trunks of trees, half hidden in the accumulating soil, we are induced to fix on an antiquity still more remote."—AVEBURY *Prehistoric Times*, ch. 8, p. 244. (A., 1900.)

202. ANTITOXINS, THEORY OF—*Immunity of Patients after Recovery from Some Diseases—Bacteria Generate Their Own Destroyers.*—Whenever bacteria, introduced into the blood and tissues, fail to multiply or produce infection, this inability to perform their rôle is brought about by some property in the living and normal blood-serum which opposes their life and action. . . . Where the blood and tissues do not possess this power, the animal is susceptible. Now, as we have already seen from the experiments of Ogata, Kitasato, and others, the blood of an animal dead of anthrax is protective against anthrax, from which and the foregoing it appears that microbes produce by their growth in the tissues poisonous substances we term toxins, which have the power of producing in the blood and body cells substances inimical to themselves, named antitoxins, and so long as these latter substances remain in the tissues the body remains insusceptible to further attacks of the same disease.—NEWMAN *Bacteria*, ch. 7, p. 249. (G. P. P., 1899.)

203. ANTS, AMAZONS AMONG—*Preparation for Success in Warfare.*—This year I have constantly seen amazons from my ant-hill depart individually and go to a great distance (as far as fifty paces from their nests), marching by jerks. I have watched them inspecting four or five nests of the Fusca ants situated more than thirty paces distant, searching for their openings and examining their surroundings with care. These facts more and more convince me that each amazon studies on her own account the situation of the nests of the slaves in the neighborhood, and that that is what enables the army to direct itself with uniformity and to make a decision at any given moment.—FOREL *Les Fourmis de la Suisse*, p. 321. (Translated for *Scientific Side-Lights.)*

204. ANTS AS KEEPERS OF LIVE STOCK—*Property in Aphids.*—I have seen the ants of two neighboring nests in dispute over their plant-lice. If those from the one strayed into that of the other, these latter would rob them from the real owners, and often these in turn would rob the robbers. For ants are aware of the value of these tiny animals that seem to have been made for them. They form their wealth; an ant-hill is rich according to its number of plant-lice; they are their live stock, their cows and goats. We had never imagined that ants were a pastoral people.—HUBER *Recherches sur les Mœurs des Fourmis Indigènes*, p. 194. (Translated for *Scientific Side-Lights.)*

205. ANTS DOMESTICATE OTHER INSECTS—*Aphides "The Cows of the Ants."*—It has long been known that ants derive a very important part of their sustenance from the sweet juice excreted by aphides. These insects, in fact, as has been over and over again observed, are the cows of the ants; in the words of Linnæus, "Aphis formicarum vacca." A good account of the relations existing between ants and aphides was given more than a hundred years ago by the Abbé Boisier de Sauvages.—AVEBURY *Ants, Bees, and Wasps*, ch. 4, p. 67. (A., 1900.)

206. ANTS, MANIFESTATIONS OF FRIENDSHIP AMONG—When ants are friendly, they have a multitude of manifestations. Sometimes they conduct themselves as if not aware of each other's presence, only they show no fear, do not take flight; or rather they stop. Then again we see both of them patting their bodies with very lively concussion before and behind, or rapidly striking the forehead or any other part of the body and then separating. At other times only one of the two will perform this maneuver facing the other, which will feel about it for a time with her antennæ. On other occasions both remain motionless in body, only striking each other with their antennæ. This last act is a less sure sign of friendship, and we often witness it between ants in doubt whether they are dealing with an enemy or a friend. One almost never sees two friends menace one another by a jesting bite or curving their abdomens around at each other. Two particular manifestations are very characteristic between two friendly ants, disgorging, and carrying one another by mutual consent. If one of the two ants is hungry or thirsty, and especially if she perceives that the crop of the other is full, which she recognizes by feeling the abdomen with her antennæ, she asks for a drink. . . . The ant (granting the request) has the appearance of enjoying it and sometimes causes two or three drops to appear, one after the other. This act of disgorging plays a very important rôle in the economy of an ant-hill; it is a perfect sign that the two ants are friends.—FOREL *Les Fourmis de la Suisse*, p. 244. (Translated for *Scientific Side-Lights.)*

207. ANTS STORING GRAIN—*Solomon's Statement Verified—Objection Refuted by Fuller Knowledge.*—None of our northern ants store up grain, and hence there has been much discussion as to the well-known passage of Solomon. . . . It is, however, now a well-established fact that more than one species of southern ants do collect seeds of various kinds. The fact, of course, has long been known in those

regions. Indeed, the quantity of grain thus stored up is sometimes so considerable that in the "Mishna" rules are laid down with reference to it; and various commentators, including the celebrated Maimonides, have discussed at length the question whether such grain belonged to the owner of the land, or might be taken by gleaners—giving the latter the benefit of the doubt. They do not appear to have considered the rights of the ants.—AVEBURY *Ants, Bees, and Wasps*, ch. 3, p. 59. (A., 1900.)

208. ANTS, THE LEAF-CUTTING SPECIES OF—*Systematic Industry among—Insects Building Thatched Roofs of Cut Leaves.*—It is a most interesting sight to see the vast host of busy diminutive laborers [the Saüba ants] occupied on this work [of leaf-cutting]. Unfortunately they choose cultivated trees for their purpose. This ant is quite peculiar to tropical America, as is the entire genus to which it belongs; it sometimes despoils the young trees of species growing wild in its native forests, but seems to prefer, when within reach, plants imported from other countries, such as the coffee and orange trees. It has not hitherto been shown satisfactorily to what use it applies the leaves. I discovered this only after much time spent in investigation. The leaves are used to thatch the domes which cover the entrances to their subterranean dwellings, thereby protecting from the deluging rains the young broods in the nests beneath. The larger mounds, already described, are so extensive that few persons would attempt to remove them for the purpose of examining their interior; but smaller hillocks, covering other entrances to the same system of tunnels and chambers, may be found in sheltered places, and these are always thatched with leaves, mingled with granules of earth. The heavily laden workers, each carrying its segment of leaf vertically, the lower edge secured in its mandibles, troop up and cast their burdens on the hillock; another relay of laborers place the leaves in position, covering them with a layer of earthy granules, which are brought one by one from the soil beneath.—BATES *Naturalist on the River Amazon*, ch. 1, p. 627. (Hum., 1880.)

209. ANTS TRACKING ONE ANOTHER BY SCENT—*Huber's Experiment.*—That ants track one another by scent was long ago mentioned by Huber, and also that they depend on this sense for their power of finding supplies which have been previously found by other ants. Huber proved their power of tracking a path previously pursued by their friends, by drawing his finger across the trail, so obliterating the scent at that point, and observing that when the ants arrived at that point they became confused and ran about in various directions till they again came upon the trail on the other side of the interrupted space, when they proceeded on their way as before. The more numerous and systematic experiments of Sir John Lubbock have fully corroborated Huber's observations.—ROMANES *Animal Intelligence*, ch. 3, p. 33. (A., 1899.)

210. ANTS USELESS OR INJURIOUS TO FLOWERS—*Nature Shuts Them Off in Favor of Bees.*—If larger flowers were visited by ants, not only would they deprive the flowers of their honey without fulfilling any useful function in return, but they would probably prevent the really useful visits of bees. If you touch an ant with a needle or a bristle, she is almost sure to seize it in her jaws; and if bees, when visiting any particular plant, were liable to have the delicate tip of their proboscis seized on by the horny jaws of an ant, we may be sure that such a species of plant would soon cease to be visited. On the other hand, we know how fond ants are of honey, and how zealously and unremittingly they search for food. How is it then that they do not anticipate the bees, and secure the honey for themselves? This is guarded against in several ways [as by hairy or slippery surfaces, cups of water around the stem, etc.].—AVEBURY *Ants, Bees, and Wasps*, ch. 3, p. 51. (A., 1900.)

211. APES, ANTHROPOID, NOT FOUND IN AMERICA—*Spider-monkey the Limit of Development in the New World—Prehensile Tails Mark American Monkeys.*—The forest at Obydos seemed to abound in monkeys, for I rarely passed a day without seeing several. I noticed four species: the Coaitá *(Ateles paniscus)*, the *Chrysothrix sciureus*, the *Callithrix torquatus*, and our old Pará friend, *Midas ursulus*. The Coaitá is a large black monkey, covered with coarse hair, and having the prominent parts of the face of a tawny flesh-colored hue. It is the largest of the Amazonian monkeys in stature, but is excelled in bulk by the "Barrigudo" *(Lagothrix humboldtii)* of the Upper Amazons. It occurs throughout the lowlands of the Lower and Upper Amazons; but does not range to the south beyond the limits of the river plains. At that point an allied species, the white-whiskered Coaitá *(Ateles marginatus)*, takes its place. The Coaitás are called by zoologists spider-monkeys, on account of the length and slenderness of their body and limbs. In these apes the tail, as a prehensile organ, reaches its highest degree of perfection; and on this account it would, perhaps, be correct to consider the Coaitás as the extreme development of the American type of apes. As far as we know, from living and fossil species, the New World has progressed no farther than the Coaitá toward the production of a higher form of the Quadrumanous order. The tendency of nature here has been, to all appearance, simply to perfect those organs which adapt the species more and more

completely to a purely arboreal life; and no nearer approach has been made toward the more advanced forms of anthropoid apes, which are the products of the Old World solely.—BATES *Naturalist on the River Amazon*, ch. 6, p. 671. (Hum., 1880.)

212. APES, CIVILIZATION MEANS EXTINCTION OF — It is pretty certain, however, that were apes as like us mentally as they are bodily, that very similarity would result in a notable difference. Some men are radicals and some conservatives, but apes would give a solid vote for the most conservative ticket, since that progress and advance of civilization which pleases most of us means, ultimately, death to them.—MIVART *Types of Animal Life*, ch. 1, p. 2. (L. B. & Co., 1893.)

213. APPEAL FROM ILLUSIVE PRESENT TO CERTAINTIES OF THE PAST—*One Sense Called to Verify Another.*—It is plain that the illusoriness of a perception is in these cases determined in relation to the sense-impressions of other moments and situations, or to what are presumably better percepts than the present one. Sometimes this involves an appeal from one sense to another. Thus, there is the process of verification of sight by touch, for example, in the case of optical images, a mode of perception which . . . gives a more direct cognition of external quality. Conversely, there may occasionally be a reference from touch to sight, when it is a question of discriminating two points lying very close to one another. Finally, the same sense may correct itself, as when the illusion of the stereoscope is corrected by afterwards looking at the two separate pictures.—SULLY *Illusions*, ch. 3, p. 38. (A., 1897.)

214. APPEARANCE OF DESIGN ACKNOWLEDGED BY DARWIN—*The Testimony of Language—Contrivance and Purpose Recognized.*—It is curious to observe the language which this most advanced disciple of pure naturalism [Darwin] instinctively uses when he has to describe the complicated structure of this curious order of plants [the orchids]. "Caution in ascribing intentions to nature," does not seem to occur to him as possible. Intention is the one thing which he does see, and which, when he does not see, he seeks for diligently until he finds it. He exhausts every form of words and of illustration by which intention or mental purpose can be described. "Contrivance"—"curious contrivance"—"beautiful contrivance"—these are expressions which recur over and over again. Here is one sentence describing the parts of a particular species: "The Labellum is developed into a long nectary, in order to attract Lepidoptera, and we shall presently give reasons for suspecting that the nectar is purposely so lodged that it can be sucked only slowly, in order to give time for the curious chemical quality of the viscid matter setting hard and dry." ["Fertilization of Orchids," p. 29.] Nor are these words used in any sense different from that in which they are applicable to the works of man's contrivance—to the instruments we use or invent for carrying into effect our own preconceived designs. On the contrary, human instruments are often selected as the aptest illustrations, both of the object in view and of the means taken to effect it. Of one particular structure, Mr. Darwin says: "This contrivance of the guiding ridges may be compared to the little instrument sometimes used for guiding a thread into the eye of a needle." Again, referring to the precautions taken to compel the insects to come to the proper spot, in order to have the "pollinia" attached to their bodies, Mr. Darwin says: "Thus we have the rostellum partially closing the mouth of the nectary, like a trap placed in a run for game—and the trap so complex and perfect"! [ibid., p. 30].—ARGYLL *Reign of Law*, ch. 1, p. 23. (Burt.)

215. APPENDAGES, USELESS, VOLUNTARILY REMOVED—*Nature's Provision for Extended Life—Ants Winged for Mating in Distant Colonies.*—I noticed that the winged termites, or white ants, which came by hundreds to the lamps at night, when alighting on the table often jerked off their wings by a voluntary movement. On examination I found that the wings were not shed by the roots, for a small portion of the stumps remained attached to the thorax. The edge of the fracture was in all cases straight, not ruptured; there is, in fact, a natural seam crossing the member toward its root, and at this point the long wing naturally drops or is jerked off when the insect has no further use for it. The white ant is endowed with wings simply for the purpose of flying away from the colony peopled by its wingless companions, to pair with individuals of the same or other colonies, and thus propagate and disseminate its kind. The winged individuals are males and females, while the great bulk of their wingless fraternity are of no sex, but are of two castes, soldiers and workers, which are restricted to the functions of building the nests, nursing, and defending the young brood.—BATES *Naturalist on the River Amazon*, ch. 5, p. 664. (Hum., 1880.)

216. APPLIANCES, DEFECTIVE, MAY GIVE GREAT RESULTS—*Earnest Workers Win Astonishing Success.*—For a long time investigators were compelled to employ plates of tourmaline for this purpose [of studying polarized light], and the progress they made with so defective a means of inquiry is astonishing. But these men had their hearts in their work, and were on this account enabled to extract great results from small instrumental appliances. But for our present purpose we need far larger apparatus; and, happily, in these later times this need has been to a great

extent satisfied.—TYNDALL *Lectures on Light,* lect. 4, p. 124. (A., 1898.)

217. APPLICATION OF KNOWLEDGE FOLLOWS ACQUISITION—*Sense of Ignorance—Desire to Know.*—Without a sense of ignorance there could be no desire of knowledge, and without his desire of knowledge man would not be man. His whole place in nature depends upon it. His curiosity, and his wonder, and his admiration, and his awe—these are all but the adjuncts and subsidiary allies of that supreme affection which incites him to inquire and know. Nor is this desire capable of being resolved into his tendency to seek for an increased command over the comforts and conveniences of life. It is wholly independent of that kind of value which consists in the physical utility of things. The application of knowledge comes after the acquisition of it, and is not the only, or even the most powerful, inducement to its pursuit. The real incitement is an innate appetite of the mind—conscious in various degrees of the mystery, and of the beauty, and of the majesty of the system in which it lives and moves; conscious, too, that its own relations to that system are but dimly seen and very imperfectly understood.—ARGYLL *Unity of Nature,* ch. 9, p. 188. (Burt.)

218. APPROXIMATIONS, GRADUAL, TO SCIENTIFIC TRUTH—*Ancient Errors.*—The history of the contemplation of the universe, as I interpret its limits, designates not so much the frequently recurring oscillations between truth and error as the principal epochs of the gradual approximation to more accurate views regarding terrestrial forces and the planetary system. It shows us that the Pythagoreans . . . taught the progressive movement of the non-rotating earth, its revolution round the focus of the world (the central fire, *hestia*), while Plato and Aristotle imagined that the earth neither rotated nor advanced in space, but that, fixed to one central point, it merely oscillated from side to side. Aristarchus of Samos, and more particularly Seleucus of Babylon, who lived one hundred and fifty years after Alexander, first arrived at the knowledge that the earth not only rotated on its own axis, but also moved round the sun as the center of the whole planetary system. And if, in the dark period of the middle ages, Christian fanaticism, and the lingering influence of the Ptolemaic school, revived a belief in the immobility of the earth, . . . it must not be forgotten that a German cardinal, Nicholas de Cusa, was the first who had the courage and the independence of mind again to ascribe to our planet, almost a hundred years before Copernicus, both rotation on its axis and translation in space. After Copernicus, the doctrines of Tycho Brahe gave a retrograde movement to science, altho this was only of short duration; and when once a large mass of accurate observations had been collected, to which Tycho Brahe himself contributed largely, a correct view of the structure of the universe could not fail to be speedily established. A period of fluctuations between truth and error is especially one of presentiments and fanciful hypotheses regarding natural philosophy.—HUMBOLDT *Cosmos,* vol. ii, pt. ii, p. 109. (H., 1897.)

219. ARABS PRESERVED GREEK LEARNING—*Value of Their Translations.*—The repugnance entertained by all the adherents of Islamism toward anatomical investigations impeded their advance in zoology. They remained contented with that which they were able to appropriate to themselves from translations of the works of Aristotle and Galen. . . . The Arabs have served as a uniting link between ancient and modern science. If it had not been for them and their love of translation, a great portion of that which the Greeks had either formed themselves, or derived from other nations, would have been lost to succeeding ages.—HUMBOLDT *Cosmos,* vol. ii, pt. ii, p. 214, 216. (H., 1897.)

220. ARCHITECTS, MICROSCOPIC—*Chalk Cliffs Built by Minute Organisms.*—The great chalk cliffs that are found on the coasts of the English Channel are the work of a sea-animal microscopic in size. At one time it was a question among scientists how these chalk cliffs were formed, but when the microscope was invented this mystery, as well as many others, was solved. The chemical components of chalk are precisely the same as those of limestone. The microscope shows that chalk is almost wholly a product of very small organized shells. The animals who are the architects of the chalk cliffs are called "foraminifera"—bearing shells perforated with little holes. The chief difference between chalk and limestone seems to be in the size of the shells of which they are respectively made up and in the manner of the bonding of these shells together. The shells in a lump of chalk are held much more loosely than those in a lump of limestone. These intrepid workers are still actively changing the structure of the bottoms of seas and oceans, and forming new islands, which in turn become the substructure that supports new life, animal and vegetable. And when we consider the great part performed by these microscopic architects and builders it is not a misnomer to speak of the building of a world.—ELISHA GRAY *Nature's Miracles,* vol. i, ch. 2, p. 20. (F. H. & H., 1900.)

221. ARCHITECTURE AMONG INSECTS—*Ants Adapt Their Homes to Convenience and Comfort.*—The chief feature of ant architecture, in contradistinction to that of bees and wasps, is the irregularity, the want of uniformity, that is to say, its adaptability, or the capacity of making all

the surroundings and incidents subserve the purpose of attaining the greatest possible economy of space and time, and the most comfort. For instance, the same species will, in the Alps, live under stones that absorb the rays of the sun; in a forest it will live in warm, decayed trunks of trees; in a rich meadow it will live in high conical mounds of earth.—AUGUSTE FOREL *Fourmis de la Suisse*, p. 181. (Translated for *Scientific Side-Lights.)*

222. ARCHITECTURE, ANCIENT AND MODERN — *Sun-dried Bricks—Straw Mixed with Clay—Modern Adobe a Survival in Fact and Name from Ancient Egypt.*—Such hut-walls of clay or mud are very usual in dry climates, such as Egypt, where they are cheaper and better than timber. This being so, there is no difficulty in understanding how sun-dried bricks came into use, these being simply convenient blocks of the same mud or loam mixed with straw which was used to build the cottage walls. These sun-dried bricks were used in the East from high antiquity. Some of the Egyptian pyramids still standing are built of them, and the pictures show how the clay was tempered and the large bricks formed in wooden molds, much as in modern brick-fields. With these the architects of Nineveh built the palace walls ten or fifteen feet thick, which were paneled with the slabs of sculptured alabaster. For such sun-dried bricks, clay and water form a sufficient cement. Building with mud-bricks, which indeed suits the climate well, goes on in these countries as of old. They were used also in America, and to this day the traveler in such districts as Mexico will often find himself lodged in a house built of them. The sun-dried brick is there called *adobe*, a word which is actually their ancient Egyptian name *tob*, which when adopted into Arabic became with the article, *at-tob*, and thence was adopted into Spanish as *adobe*. Baked bricks seem to have been a later invention, easy enough to nations who baked earthen pots, but only wanted in more rainy climates. Thus the Romans, whom mere mud-bricks would not have suited, carried to great perfection the making of kiln-burnt bricks and tiles.—TYLOR *Anthropology*, ch. 10, p. 234. (A., 1899.)

223. ARCHITECTURE, DEVICES OF, ANTICIPATED—*Buttresses Built around Tropical Trees—Roots Spring Up to Sustain Massive Crown.*—A very remarkable feature in these trees is the growth of buttress-shaped projections around the lower part of their stems. The spaces between these buttresses, which are generally thin walls of wood, form spacious chambers, and may be compared to stalls in a stable; some of them are large enough to hold half a dozen persons. The purpose of these structures is as obvious, at the first glance, as that of the similar props of brickwork which support a high wall. They are not peculiar to one species, but are common to most of the larger forest-trees. Their nature and manner of growth are explained when a series of young trees of different ages is examined. It is then seen that they are the roots which have raised themselves ridge-like out of the earth; growing gradually upward as the increasing height of the tree required augmented support. Thus they are plainly intended to sustain the massive crown and trunk in these crowded forests, where lateral growth of the roots in the earth is rendered difficult by the multitude of competitors.—BATES *Naturalist on the Amazon*, ch. 2, p. 635. (Hum., 1880.)

224. ARCHITECTURE OF THE EARTH —*Basaltic Columns the Silent Memorials of Past Convulsions—Fingal's Cave—The Giant's Causeway.*—The remarkable grotto known as Fingal's Cave, in the Island of Staffa, has been formed in the midst of a lava-stream; the thick vertical columns, which rise from beneath the level of the sea, are divided by joints and have been broken away by the action of the sea; in this way a great cavern has been produced, the sides of which are formed by vertical columns, while the roof is made up of smaller and interlacing ones. The whole structure bears some resemblance to a Gothic cathedral; the sea finding access to its floor of broken columns, and permitting the entrance of a boat during fine weather. Similar, tho perhaps less striking, structures are found in many other parts of the globe wherever basaltic and other lava-streams exhibit the remarkable columnar structure as the result of their slow cooling. . . . This kind of structure is admirably displayed at the Giant's Causeway, County Antrim, in the north of Ireland.—JUDD *Volcanoes*, ch. 4, p. 107. (A., 1899.)

225. AREA, TRIFLING, OF CORAL ISLANDS—*Archipelago Less than a City.*—To show how small the total area of the annular reef and the land is in islands of this class [coral atolls], I may quote a remark from the voyage of Lutké, namely, that if the forty-three rings, or atolls, in the Caroline Archipelago were put one within another, and over a steeple in the center of St. Petersburg, the whole would not cover that city and its suburbs.—DARWIN *Coral Reefs*, ch. 1, p. 29. (A., 1900.)

226. ARGUMENT A PRIORI CANNOT DETERMINE FACT—*Popular Belief in Meteorites Scouted by Early Scientists.*—Among the many superstitions of the early world and credulous fancies of the middle ages was the belief that great stones sometimes fell down out of heaven onto the earth.

Pliny has a story of such a black stone, big enough to load a chariot; the Mussulman still adores one at Mecca; and a medieval emperor of Germany had a sword which was said to have been forged from

one of these bolts shot out of the blue. But with the revival of learning, people came to know better! That stones should fall down from the sky was clearly, they thought, an absurdity; indeed, according to the learned opinion of that time, one would hardly ask a better instance of the difference between the realities which science recognized and the absurdities which it condemned than the fancy that such a thing could be.—LANGLEY *New Astronomy*, ch. 6, p. 175. (H. M. & Co., 1896.)

227. ARGUMENT FROM DESIGN—*Plan Not Less Divine for Lapse of Time—Unity Perfect—Interpositions Not Needed.*—Accepting provisionally, then, the doctrine of evolution in this widest sense, as implying the common origin of the whole organized creation—past and present—from a single stock, we shall find that no further modification will be required in the form in which I have put the argument, from design, than such as gives it yet further range and greater comprehensiveness. For we must then regard our one ancestral germ-particle as endowed with a "potentiality" of progressive development that has been equal to the peopling of our globe with all that vast variety of living creatures, by some or other of which it has been inhabited through all save the remotest periods of its ever-changing history to the present time. That this progressive development has taken place according to an orderly succession, the study of which will ultimately enable us to frame "laws" that shall express the conditions of the "perturbations" as well as of the "uniformities" of genetic descent, is the belief of every philosophic biologist. But when biological science shall have reached this elevated point, it will have revealed to us only the order of the evolutionary process, leaving us still to seek for its cause. But how much grander a conception of that order do we obtain when we are thus led to regard it as embodied in one original design continuously working itself out through the ages, in constant harmony with the changes contemporaneously taking place in the condition of the terrestrial surface, than when we suppose it to have needed successive interpositions for readaptation to those changes as they successively occurred!—CARPENTER *Nature and Man*, lect. 15, p. 434. (A., 1889.)

228. ARITHMETIC OF PRIMITIVE MAN—*Standards of Computation Limited.*—The standards of compound arithmetic were very low among the Andamanese. About forty pounds was a man's load, and anything above that would simply be more than a man's load. Size was rated by well-known natural objects, seeds, fruits, nuts, etc. Capacity was counted by handfuls, basketfuls, bucketfuls, canoefuls. There is no prescribed form or dimensions for any object. No tallies were kept nor counters, and this is very low down, because all American tribes knew the use of tallies. Distance was spoken of as a bowshot, or as from there to there, indicating the limits Fifteen miles, about, was a day's journey, and over that was said to "exceed a day's journey."—MASON *Origins of Invention*, ch. 2, p. 69. (S., 1899.)

229. ARMOR DERIVED FROM ANIMALS—*The Cuirass Originally of Leather—Later Imitation of the Scales of Fish or Reptile.*—How the warrior's armor comes from the natural armor of animals is plainly to be seen. The beast's own hide may be used, as where one sees in museums the armor of bearskins from Borneo, or breastplates of crocodile's skin from Egypt. The name of the cuirass shows that it was at first of leather, like the buff jerkin. The Bugis of Sumatra would make a breastplate by sewing upon bark the cast-off scales of the ant-eater, overlapping as the animal wore them; and so the natural armor of animals was imitated by the Sarmatians, with their slices of horses' hoofs sewed together in overlapping scales like a fir-cone. Such devices, when metal came in, would lead to the scale armor of the Greeks, imitated from fish-scales and serpent-scales, while their chain-mail is a sort of netted garment made in metal. The armor of the middle ages continued the ancient kinds, now protecting the whole body with a suit from head to foot (cap-à-pie) of iron scales, or mail (that is, meshes), or of jointed plates of iron copied from the crab and lobster, such as the later suits of armor which decorate our manorial halls.—TYLOR *Anthropology*, ch. 9, p. 222. (A., 1899.)

230. ARREST OF THE BODY—*Man Walking Erect and Making Tools Thenceforth Developed Mind.*—From the time when the ancestral man first walked erect, with hands freed from any active part in locomotion, and when his brain-power became sufficient to cause him to use his hands in making weapons and tools, houses and clothing, to use fire for cooking, and to plant seeds or roots to supply himself with stores of food, the power of natural selection would cease to act in producing modifications of his body, but would continuously advance his mind through the development of its organ, the brain. Hence man may have become truly man—the species, *Homo sapiens*—even in the Miocene period; and while all other mammals were becoming modified from age to age under the influence of ever-changing physical, and biological conditions, he would be advancing mainly in intelligence, but perhaps also in stature, and by that advance alone would be able to maintain himself as the master of all other animals and as the most wide-spread occupier of the earth.—WALLACE *Darwinism*, ch. 15, p. 308. (Hum.)

231. ——— ——— *Man Will Develop No Further as an Animal.*—"On the earth there will never be a higher creature than man" (Fiske, "Destiny of Man," p. 26). It is a daring prophecy, but every probability of science attests the likelihood of its fulfilment.

This is not a conceit of science, nor a reminiscence of the pre-Copernican idea that the center of the universe is the world, and the center of the world man. It is the sober scientific probability that with the body of man the final fruit of the tree of organic evolution has appeared; that the highest possibilities open to flesh and bone and nerve and muscle have now been realized; that in whatever direction, and with whatever materials, evolution still may work, it will never produce any material thing more perfect in design or workmanship; that in man, in short, about this time in history, we are confronted with a stupendous crisis in Nature—the arrest of the animal.—DRUMMOND *Ascent of Man,* ch. 3, p. 99. (J. P., 1900.)

232. ARREST OF THE HAND—*Tools Are External Hands.*—As the hand was given more and more to do, it became more and more adapted to its work. Up to a point, it responded directly to each new duty that was laid upon it; but only up to a point. There came a time when the necessities became too numerous and too varied for adaptation to keep pace with them. And the fatal day came, the fatal day for the hand, when he who bore it made a new discovery. It was the discovery of tools. Henceforth what the hand used to do, and was slowly becoming adapted to do better, was to be done by external appliances; so that if anything new arose to be done, or to be better done, it was not a better hand that was now made, but a better tool. Tools are external hands. Levers are the extensions of the bones of the arm. Hammers are callous substitutes for the fist. Knives do the work of nails. The vise and the pincers replace the fingers. The day that caveman first split the marrow-bone of a bear by thrusting a stick into it, and striking it home with a stone—that day the doom of the hand was sealed.—DRUMMOND *Ascent of Man,* ch. 3, p. 102. (J. P., 1900.)

233. ART AMONG ANCIENT CAVE-MEN—*Forgeries Detected by Lack of Antique Skill—Pictures Made by Australian and South African Savages.*—The sketches and carvings of animals done by the old cave-men of Europe have so artistic a touch that some have supposed them modern forgeries. But they are admitted to be genuine and found over a wide district, while forgeries which have been really done to palm off on collectors are just wanting in the peculiar skill with which the savages who lived among the reindeer and mammoths knew how to catch their forms and attitudes. . . . The art of coloring would naturally arise, for savages who paint their own bodies with charcoal, pipe-clay, and red and yellow ocher, would daub their carved figures and fill in their outline drawings with the same colors. Travelers in Australia, sheltering from the storm in caves, wonder at the cleverness of the rude frescos on the cavern-walls of kangaroos and emus and natives dancing, while in South Africa the bushmen's caves show paintings of themselves with bows and arrows, and the bullock-wagons of the white men, and the dreaded figure of the Dutch Boer with his broad-brimmed hat and pipe.—TYLOR *Anthropology,* ch. 12, p. 301. (A., 1899.)

234. ARTIFICIALITY DESTROYS MENTAL FREEDOM—*True Love of Nature Wanting in Persian Poetry.*—Both Iran and Turan are wanting in woodland scenery, and also, therefore, in the hermit life of the forest, which exercised so powerful an influence on the imagination of the Indian poets. Gardens refreshed by cool springs, and filled with roses and fruit-trees, can form no substitute for the wild and grand natural scenery of Hindustan. It is no wonder, then, that the descriptive poetry of Persia was less fresh and animated, and that it was often heavy and overcharged with artificial adornment. . . . Sadi, in his *Bostan and Gulistan* (Fruit and Rose Gardens), may be regarded as indicating an age of ethical teaching, while Hafiz, whose joyous views of life have caused him to be compared to Horace, may be considered by his love-songs as the type of a high development of lyrical art; but in both bombastic affectation too frequently mars the descriptions of nature. The darling subject of Persian poetry, the "loves of the nightingale and the rose," recurs with wearying frequency, and a genuine love of nature is lost in the East amid the artificial conventionalities of the language of flowers.—HUMBOLDT *Cosmos,* vol. ii. pt. i. p. 54. (H., 1897.)

235. ARTISAN MAY BECOME A SCHOLAR—*Opportunities of Stone-mason in Geology.*—I advise the stone-mason, for instance, to acquaint himself with geology. Much of his time must be spent amid the rocks and quarries of widely separated localities. . . . In some respects his advantages are superior to those of the amateur himself. The latter must often pronounce a formation unfossiliferous when, after the examination of at most a few days, he discovers in it nothing organic; and it will be found that half the mistakes of geologists have arisen from conclusions thus hastily formed. But the working man, whose employments have to be carried on in the same formation for months, perhaps years, together, enjoys better opportunities for arriving at just decisions. There are, besides, a thousand varieties of accident which lead to discovery—floods, storms, landslips, tides of unusual height, ebbs of

extraordinary fall: and the man who plies his labor at all seasons in the open air has by much the best chance of profiting by these. There are formations which yield their organisms slowly to the discoverer, and the proofs which establish their place in the geological scale more tardily still. I was acquainted with the old red sandstone of Ross and Cromarty for nearly ten years ere I had ascertained that it is richly fossiliferous—a discovery which, in exploring this formation in those localities, some of our first geologists had failed to anticipate. I was acquainted with it for nearly ten years more ere I could assign to its fossils their exact place in the scale.—MILLER *The Old Red Sandstone*, ch. 1, p. 13. (G. & L., 1851.)

236. ARTIST FEARING BLINDNESS—*Scientist Explains Difficulty—Prediction of Recovery Fulfilled.*—One of the most interesting cases of diffraction by small particles that ever came before me was that of an artist whose vision was disturbed by vividly colored circles. He was in great dread of losing his sight; assigning as a cause of his increased fear that the circles were becoming larger and the colors more vivid. I ascribed the colors to minute particles in the humors of the eye, and ventured to encourage him by the assurance that the increase of size and vividness on the part of the circles indicated that the diffracting particles were becoming smaller, and that they might finally be altogether absorbed. The prediction was verified.—TYNDALL *Lectures on Light*, lect. 2, p. 92. (A., 1898.)

237. ARTIST, SCIENTIFIC BLUNDER OF—*Asiatic Monkey Given Prehensile Tail.*—An amusing illustration of the wide-spread ignorance which exists as to such matters, and also of the use of the imagination in a way not strictly scientific, occurred with reference to the Prince of Wales's visit to India some years ago. Among other places of interest the Prince visited was the Temple of Monkeys at Benares. His visit was duly depicted in one of the illustrated journals, and no doubt with scrupulous fidelity in all these points to which the artist directed his attention. Nevertheless these monkeys are represented as having prehensile tails; which is about as accurate as would be a picture of a fox-hunt by a supposed eye-witness wherein the hounds should be represented each with a fox's brush for tail [none but American monkeys having prehensile tails].—MIVART *Types of Animal Life*, ch. 1, p. 5. (L. B. & Co., 1893.)

238. ARTIST, SELECTION THE SECRET OF HIS POWER—*Beauty of Works of Art Due to Elimination.*—The artist selects his items, rejecting all tones, colors, shapes, which do not harmonize with each other and with the main purpose of his work. That unity, harmony, "convergence of characters," as M. Taine calls it, which gives to works of art their superiority over works of nature, is wholly due to elimination. Any natural subject will do, if the artist has wit enough to pounce upon some one feature of it as characteristic, and suppress all merely accidental items which do not harmonize with this.—JAMES *Psychology*, vol. i, ch. 9, p. 287. (H. H. & Co., 1899.)

239. ARTS AND SCIENCES, GROWTH OF—*From Bow through Crossbow to Musket.*—Arts and sciences never spring forth perfect, like Athene out of the split head of Zeus. They come on by successive steps, and where other information fails the observer may often trust himself to judge from the mere look of an invention how it probably arose. Thus no one can look at a crossbow and a common longbow without being convinced that the longbow was the earlier, and that the crossbow was made afterwards by fitting a common bow on a stock, and arranging a trigger to let go the string after taking aim. Tho history fails to tell us who did this and when, we feel almost as sure of it as of the known historical facts that the crossbow led up to the matchlock, and that again to the flint-lock musket, and that again to the percussion musket, and that again to the breech-loading rifle.—TYLOR *Anthropology*, ch. 1, p. 18. (A., 1899.)

240. ASCENT FROM BRUTE TO MAN—*Alpine Heights of Intellect—Marvelous Endowment of Speech—Spiritual Exaltation.*—Nay, more; thoughtful men, once escaped from the blinding influences of traditional prejudice, will find in the lowly stock whence man has sprung the best evidence of the splendor of his capacities, and will discern in his long progress through the past a reasonable ground of faith in his attainment of a nobler future.

They will remember that in comparing civilized man with the animal world one is as the Alpine traveler, who sees the mountains soaring into the sky, and can hardly discern where the deep-shadowed crags and roseate peaks end and where the clouds of heaven begin. Surely the awe-struck voyager may be excused if at first he refuses to believe the geologist, who tells him that these glorious masses are, after all, the hardened mud of primeval seas, or the cooled slag of subterranean furnaces—of one substance with the dullest clay, but raised by inward forces to that place of proud and seemingly inaccessible glory.

But the geologist is right: and due reflection on his teachings, instead of diminishing our reverence and our wonder, adds all the force of intellectual sublimity to the more esthetic intuition of the uninstructed beholder.

And after passion and prejudice have died away the same result will attend the teachings of the naturalist respecting that great Alps and Andes of the living world—

man. Our reverence for the nobility of manhood will not be lessened by the knowledge that man is, in substance and in structure, one with the brutes: for he alone possesses the marvelous endowment of intelligible and rational speech whereby, in the secular period of his existence, he has slowly accumulated and organized the experience which is almost wholly lost with the cessation of every individual life in other animals; so that now he stands raised upon it as on a mountain-top, far above the level of his humble fellows, and transfigured from his grosser nature by reflecting, here and there, a ray from the infinite source of truth.—HUXLEY *Man's Place in Nature*, p. 234. (Hum.)

241. ASPIRATION OF SCIENCE LIMITLESS — The idea of limitation to thought or achievement no longer enters the imagination. The depth of the sea, the distances of the stars, the concealment of the earth's treasures, the minuteness of the springs of life and sense, the multiplicity and complicity of phenomena are only so many incitements to greater achievements. The daring souls of this decade are determined at any risk to answer the inquiry of Pontius Pilate, What is truth? With sympathetic enthusiasm we wave them on, bidding them Godspeed.—MASON *The Birth of Invention.* An Address. [Washington, D. C., 1891.]

242. ASSIMILATION OF COLOR TO ENVIRONMENT—*Transparency of Pelagic Animals.*—An . . . illustration of general assimilation of color to the surroundings of animals is furnished by the inhabitants of the deep oceans. Professor Moseley, of the Challenger Expedition, in his British Association lecture on this subject, says: "Most characteristic of pelagic animals is the almost crystalline transparency of their bodies. So perfect is this transparency that very many of them are rendered almost entirely invisible when floating in the water, while some, even when caught and held up in a glass globe, are hardly to be seen. The skin, nerves, muscles, and other organs are absolutely hyaline and transparent, but the liver and digestive tract often remain opaque and of a yellow or brown color, and exactly resemble when seen in the water small pieces of floating seaweed." Such marine organisms, however, as are of larger size, and either occasionally or habitually float on the surface, are beautifully tinged with blue above, thus harmonizing with the color of the sea as seen by hovering birds; while they are white below, and are thus invisible against the wave-foam and clouds as seen by enemies beneath the surface. Such are the tints of the beautiful nudibranchiate mollusk, *Glaucus atlanticus*, and many others.—WALLACE *Darwinism*, ch. 5, p. 132. (Hum., 1889.)

243. ASSOCIATION A SOURCE OF POWER—*Gregarious Animals, However Defenseless, Survive—Each Has the Foresight and Perception of the Herd.*—One of these advantages [of gregariousness], obviously, is the mere physical strength of numbers. But there is another and a much more important one—the mental strength of a combination. Here is a herd of deer, scattered, as they love to be, in a string, a quarter of a mile long. Every animal in the herd not only shares the physical strength of all the rest, but their powers of observation. Its foresight in presence of possible danger is the foresight of the herd. It has as many eyes as the herd, as many ears, as many organs of smell; its nervous system extends throughout the whole space covered by the line; its environment, in short, is not only what it hears, sees, smells, touches, tastes, but what every single member hears, sees, smells, touches, tastes. This means an enormous advantage in the struggle for life. What deer have to arm themselves most against is surprise. When it comes to an actual fight, comrades are of little use. At that crisis the others run away and leave the victims to their fate. But in helping one another to avert that crisis, the value of this mutual aid is so great that gregarious animals, for the most part timid and defenseless as individuals, have survived to occupy in untold multitudes the highest places in nature.—DRUMMOND *Ascent of Man*, p. 155. (J. P., 1900.)

244. ASSOCIATION IN THOUGHT—*Interdependence of the Various Parts of the Brain.*—Every namable thing, act, or relation has numerous properties, qualities, or aspects. In our minds the properties of each thing, together with its name, form an associated group. If different parts of the brain are severally concerned with the several properties, and a farther part with the hearing, and still another with the uttering, of the name, there must inevitably be brought about (through the law of association) such a dynamic connection amongst all these brain-parts that the activity of any one of them will be likely to awaken the activity of all the rest. When we are talking as we think, the ultimate process is that of utterance. If the brain-part for that be injured, speech is impossible or disorderly, even tho all the other brain-parts be intact.—JAMES *Psychology*, vol. i, ch. 2, p. 57. (H. H. & Co., 1899.)

245. ASSOCIATION OF THE IMPRESSIONS OF DIFFERENT SENSES—*Touch Awakens Memories of Sight and Sound.*—Association occurs as amply between impressions of different senses as between homogeneous sensations. Seen things and heard things cohere with each other, and with odors and tastes, in representation, in the same order in which they cohered as impressions of the outer world. Feelings of contact reproduce similarly the sights,

sounds, and tastes with which experience has associated them. In fact, the "objects" of our perception, as trees, men, houses, microscopes, of which the real world seems composed, are nothing but clusters of qualities which through simultaneous stimulation have so coalesced that the moment one is excited actually it serves as a sign or cue for the idea of the others to rise. Let a person enter his room in the dark and grope among the objects there. The touch of the matches will instantaneously recall their appearance. If his hand comes in contact with an orange on the table, the golden yellow of the fruit, its savor and perfume will forthwith shoot through his mind. In passing the hand over the sideboard or in jogging the coal-scuttle with the foot, the large, glossy, dark shape of the one and the irregular blackness of the other awaken like a flash and constitute what we call the recognition of the objects. The voice of the violin faintly echoes through the mind as the hand is laid upon it in the dark, and the feeling of the garments or draperies which may hang about the room is not understood till the look correlative to the feeling has in each case been resuscitated. . . . We cannot hear the din of a railroad train or the yell of its whistle without thinking of its long, jointed appearance and its headlong speed, nor catch a familiar voice in a crowd without recalling, with the name of the speaker, also his face.—JAMES *Psychology*, vol. i, ch. 14, p. 555. (H. H. & Co., 1899.)

246. ASSOCIATION, THE SPIRIT OF —*Power of Voluntary Societies—Church—Country.*—New motives can be evoked and put in action by the adopting of appropriate means. The mere founding, for example, of a voluntary society for any given purpose evolves out of the primary elements of human character a latent force of the most powerful kind, namely, the motive—the sentiment—the feeling—the passion, as it often is, of the spirit of association. This is a passion which defies analysis. The cynic may reduce it to a form of selfishness—and undoubtedly the identification of the interests, and the desires of self with the society for which this passion is conceived, lies at its very root and is of its very essence. It is true, also, that it is a passion so powerful as to need strong control—without which control it generates some of the very meanest emotions of the heart. Out of it there has come, and there comes again and again from age to age, a spirit of hatred even against good itself, when that good is the work of any one who "followeth not us." It is a force, nevertheless, rooted in the nature of man, implanted there as part of its constitution, and, like all others of this character, given him for a purpose, and having its own legitimate field of operation. Nor is that field a narrow one. The spirit of association is the fountain of much that is noblest in human character, and of much that is most heroic in human conduct. For all the desires and aspirations of self are not selfish. The interests of self, justly appreciated and rightly understood, may be, nay indeed must be, the interests also of other men—of society —of country—of the church, and of the world.—ARGYLL *Reign of Law*, ch. 7, p. 219. (Burt.)

247. ASSUMPTION NECESSARY TO MAINTAIN A THEORY—*Spontaneous Generation Never Known—Assumed in Order to Dispense with a Creator.*—The origin of the first Monera by spontaneous generation appears to us as a simple and necessary event in the process of the development of the earth. We admit that this process, as long as it is not directly observed or repeated by experiment, remains a pure hypothesis. But I must again say that this hypothesis is indispensable for the consistent completion of the non-miraculous history of creation, that it has absolutely nothing forced or miraculous about it, and that certainly it can never be positively refuted. It must also be taken into consideration that the process of spontaneous generation, even if it still took place daily and hourly, would in any case be exceedingly difficult to observe and establish with absolute certainty as such. This is also the opinion of Naegeli, the ingenious investigator, and he, in his admirable chapter on spontaneous generation, maintains that "to deny spontaneous generation is to proclaim miracles."—HAECKEL *History of Creation*, vol. i, ch. 15, p. 422. (K. P. & Co., 1899.)

248. ASSUMPTIONS OF MONISM—*Spontaneous Generation Never Proved—Mind to Be Evolved from Fire-mist—Faith Demanded in Philosophic Creed.*—It is plain that we might here enter our dissent from Haeckel's method, for he requires us, before we can proceed a single step in the evolution of man, to assume many things which he cannot prove. What evidence is there, for example, of the possibility of the development of the rational and moral nature of man from the intelligence and the instinct of the lower animals, or of the necessary dependence of the phenomena of mind on the structure of brain-cells? The evidence, so far as it goes, seems to tend the other way. What proof is there of the spontaneous evolution of living forms from inorganic matter? Experiment so far negatives the possibility of this. Even if we give Haeckel, to begin with, a single living cell or granule of protoplasm, we know that this protoplasm must have been produced by the agency of a living vegetable cell previously existing: and we have no proof that it can be produced in any other way. Again, what particle of evidence have we that the atoms or the energy of an incandescent fire-mist have in them anything of

the power or potency of life? We must grant the monist all these postulates as pure matters of faith before he can begin his demonstration; and, as none of them are axiomatic truths, it is evident that so far he is simply a believer in the dogmas of a philosophic creed, and in this respect weak as other men whom he affects to despise.—DAWSON *Facts and Fancies in Modern Science*, lect. 1, p. 58. (A. B. P. S.)

249. ASSURANCE OF OUR OWN REALITY — We reach thus the important conclusion that our own reality, that sense of our own life which we at every moment possess, is the ultimate of ultimates for our belief. "As sure as I exist!"—this is our uttermost warrant for the being of all other things.—JAMES *Psychology*, vol. ii, ch. 21, p. 297. (H. H. & Co., 1899.)

250. ASTEROIDS, COUNTLESS HOST OF—*Photography Surpasses the Human Eye in Observing—Study of This Band a Special Department of Science.*—The detection of new members of the solar system has come to be one of the most ordinary of astronomical events. Since 1846 no single year has passed without bringing its tribute of asteroidal discovery. . . . Both [time and diligence] are vastly economized by the photographic method. Tedious comparisons of the sky with charts are no longer needed for the identification of unrecorded, because simulated, stars. Planetary bodies declare themselves by appearing upon properly exposed sensitive plates, not in circular, but in linear form. Their motion converts their images into trails, long or short according to the time of exposure. . . . Far more onerous than the task of their discovery is that of keeping them in view once discovered—of tracking out their paths, fixing their places, and calculating the disturbing effects upon them of the mighty Jovian mass. These complex operations have come to be centralized at Berlin under the superintendence of Professor Tietjen, and their results are given to the public through the medium of the *Berliner Astronomisches Jahrbuch.*—CLERKE *History of Astronomy*, pt. ii, ch. 8, p. 346. (Bl., 1893.)

251. ASTRONOMY A CONTINUOUS SCIENCE—*Each Discoverer Builds on Previous Discoveries.*—The theory of universal gravitation was founded by Newton upon the laws of Kepler, the observations and measurements of his French contemporaries, and the geometry of Apollonius. Kepler used as his material the observations of Tycho Brahe, and built upon the theory of Copernicus. When we seek the origin of the instruments used by Tycho, we soon find ourselves among the medieval Arabs. The discovery of the true system of the world by Copernicus was only possible by a careful study of the laws of apparent motion of the planets as expressed in the epicycles of Ptolemy and Hipparchus. Indeed, the more carefully one studies the great work of Copernicus, the more surprised he will be to find how completely Ptolemy furnished him both ideas and material. If we seek the teachers and predecessors of Hipparchus, we find only the shadowy forms of Egyptian and Babylonian priests, whose names and writings are all entirely lost. In the earliest historic ages, men knew that the earth was round; that the sun appeared to make an annual revolution among the stars; and that eclipses were caused by the moon entering the shadow of the earth, or the earth that of the moon.—NEWCOMB *Popular Astronomy*, pt. i, int., p. 1. (H., 1899.)

252. ASTRONOMY, FASCINATION OF—*Compared with Novel-reading—Astronomy Instructs—The Novel Gives No Advance in Knowledge.*—Such a book [a popular treatise on astronomy], altho of more real interest and more attractive than a novel, should be read with attention, and only on this condition can the ideas it contains impart lasting scientific instruction. But whereas when we reach the last page of a novel we know just as much as when we began the first, we must be either blind or oblivious to all intellectual apprehension if the reading of a scientific work does not greatly extend the sphere of our knowledge, and does not more and more elevate the level of our judgment. We might even say that in our age it should be impossible for any one's mind to be so little cultivated as to remain in ignorance of the absolute truths revealed by the grand conquests of modern astronomy.—FLAMMARION *Popular Astronomy*, p. 2. (A.)

253. ASTRONOMY, GENERALIZATIONS OF—*The Indefinitely Great and the Indefinitely Little Alike Her Province.*—Astronomy generalizes the results of other sciences. She exhibits the laws of Nature working over a wider area, and under more varied conditions, than ordinary experience presents. Ordinary experience, on the other hand, has become indispensable to her progress. She takes in at one view the indefinitely great and the indefinitely little. The mutual revolutions of the stellar multitude during tracts of time which seem to lengthen out to eternity as the mind attempts to traverse them, she does not admit to be beyond her ken; nor is she indifferent to the constitution of the minutest atom of matter that thrills the ether into light.—CLERKE *History of Astronomy*, int., p. 9. (Bl., 1893.)

254. ASTRONOMY IN ANCIENT EGYPT—*Discoveries Recorded in Structure of the Pyramids.*—The Egyptians, who built the great pyramids more than forty centuries ago, constructed the passages which permit us to penetrate into the interior exactly in the direction of the north, and at an inclination of 27 degrees, which is precisely

the altitude which the pole star of that day, α Draconis, attained at its lower transit across the meridian.—FLAMMARION *Popular Astronomy*, p. 39. (A.)

255. ASTRONOMY IN CHINA—*More Fitly Termed Astrology—Calculations Grossly Erroneous.*—Arguments in support of the presumed knowledge of the Chinese regarding navigation are often based on their alleged attainments in astronomy; for they have undoubtedly studied the phenomena dealt with by that science since time immemorial. But their calculations of eclipses have been found erroneous; and the astronomer Cassini, in examining an observation of one winter solstice very celebrated in their annals, discovered therein an error of no less than 487 years. They are rather astrologers than astronomers, and their tribunal of mathematics, existing, as it has, for centuries, has found its chief occupation in indicating to the government fortunate days for national enterprises or ceremonials rather than in gathering the results of observation. In brief, their system of astronomy is rigidity itself, and if its predictions fail they argue that the fault is not in themselves, but in their stars, and settle the matter by deferring further prophecy until after the event.—PARK BENJAMIN *Intellectual Rise in Electricity*, ch. 3, p. 79. (J. W., 1898.)

256. ASTRONOMY MADE POSSIBLE BY MATHEMATICS—*Ancient Thinkers Prepared the Way for Modern Discoverers—Reason Directs the Telescope.*—The age of the Ptolemies was a most brilliant epoch in the prosecution of mathematical investigations. In the same century there appeared Euclid, the creator of mathematics as a science; Apollonius of Perga, and Archimedes, who visited Egypt, and was connected through Conon with the school of Alexandria. The long period of time which leads from the so-called geometrical analysis of Plato . . . to the age of Kepler and Tycho Brahe, Euler and Clairaut, D'Alembert and Laplace, is marked by a series of mathematical discoveries without which the laws of the motion of the heavenly bodies and their mutual relations in the regions of space would not have been revealed to mankind. While the telescope serves as a means of penetrating space, and of bringing its remotest regions nearer to us, mathematics, by inductive reasoning, have led us onward to the remotest regions of heaven, and brought a portion of them within the range of our possession; nay, in our own times—so propitious to extension of knowledge—the application of all the elements yielded by the present condition of astronomy has even revealed to the intellectual eye a heavenly body, and assigned to it its place, orbit, and mass, before a single telescope had been directed toward it. —HUMBOLDT *Cosmos*, vol. ii, pt. ii, p. 179. (H., 1897.)

257. ASTRONOMY OF ANTIQUITY—*Substitute for the Telescope—Lensless Tubes Excluded Diffused Light.*—We find, without including the epoch of the Chaldeans, Egyptians, and Chinese, that more than nineteen centuries intervened between the age of Timochares and Aristillus and the discoveries of Galileo, during which period the position and course of the stars were observed by the eye alone, unaided by instruments. . . . We are astonished that Hipparchus and Ptolemy should have been so well acquainted with the precession of the equinoxes, the complicated movements of the planets, the two principal inequalities of the moon, and the position of the stars; that Copernicus should have had so great a knowledge of the true system of the universe; and that Tycho Brahe should have been so familiar with the methods of practical astronomy before the discovery of the telescope. Long tubes, which were certainly employed by Arabian astronomers, and very probably also by the Greeks and Romans, may indeed, in some degree, have increased the exactness of the observations by causing the object to be seen through diopters or slits. Abul-Hassan speaks very distinctly of tubes, to the extremities of which ocular and object diopters were attached; and instruments so constructed were used in the observatory founded by Hulagu at Meragha. If stars be more easily discovered during twilight by means of tubes, and if a star be sooner revealed to the naked eye through a tube than without it, the reason lies, as Arago has already observed, in the circumstance that the tube conceals a great portion of the disturbing light diffused in the atmospheric strata between the star and the eye applied to the tube. In like manner, the tube prevents the lateral impression of the faint light which the particles of air receive at night from all the other stars in the firmament. The intensity of the image and the size of the star are apparently augmented. In a frequently emendated and much contested passage of Strabo, in which mention is made of looking through tubes, this "enlarged form of the stars" is expressly mentioned, and is erroneously ascribed to refraction.—HUMBOLDT *Cosmos*, vol. iii, p. 42. (H., 1897.)

258. ASTRONOMY OF THE EARLY WORLD—*A Slow Growth through Protracted Observation.*—Wherever steppes, grassy plains, or sandy wastes present a far-extended horizon, those constellations whose rising or setting corresponds with the busy seasons and requirements of pastoral and agricultural life have become the subject of attentive consideration, and have gradually led to a symbolizing connection of ideas. Men thus became familiarized with the aspect of the heavens before the development of measuring astronomy. They soon perceived that besides the daily movement from east to west, which is common

to all celestial bodies, the sun has a far slower proper motion in an opposite direction. The stars which shine in the evening sky sink lower every day, until at length they are wholly lost amid the rays of the setting sun; while, on the other hand, those stars which were shining in the morning sky, before the rising of the sun, recede further and further from it. In the ever-changing aspect of the starry heavens successive constellations are always coming to view. A slight degree of attention suffices to show that these are the same which had before vanished in the west, and that the stars which are opposite to the sun, setting at its rise and rising at its setting, had about half a year earlier been seen in its vicinity. From the time of Hesiod to Eudoxus, and from the latter to Aratus and Hipparchus, Hellenic literature abounds in metaphoric allusions to the disappearance of the stars amid the sun's rays, and their appearance in the morning twilight—their heliacal setting and rising. An attentive observation of these phenomena yielded the earliest elements of chronology, which were simply expressed in numbers, while mythology, in accordance with the more cheerful or gloomy tone of national character, continued simultaneously to rule the heavens with arbitrary despotism.—HUMBOLDT *Cosmos*, vol. iii, p. 118. (H., 1897.)

259. ASTRONOMY ORIGINATED WITH THE MOON—The light of the moon was the first astronomical illumination. Science commenced with this dawn, and age by age it has conquered the stars and the immense universe. This sweet and calm light releases our thoughts from terrestrial bonds and compels us to think of the sky; then the study of other worlds develops, observations increase, and astronomy is founded. It is not yet the heavens, and it is already more than the earth. The silent star of night is the first halting-place on a voyage towards the infinite.—FLAMMARION *Popular Astronomy*, bk. ii, ch. 1, p. 81. (A.)

260. ASTRONOMY, PRECISION OF—*Eclipses Predicted Centuries in Advance—Traced Back Centuries in the Past—Missing Date of Herodotus Supplied—Uniformity of Nature Proved.*—Now, on the contrary, with the much more precise knowledge we have of the moon's motion, we are in a position to calculate and foretell for a great number of years, and even centuries in advance, not only the general circumstances of eclipses of the moon, but even the detailed course of eclipses of the sun. We can even, by a retrospective examination, give an account of all the circumstances which an ancient eclipse should have presented in such or such a locality, and find the precise date of certain historical events of which the epoch is a subject of discussion. An eclipse of the sun is a veritable rarity for any given place. (Thus, for example, there has not been one at Paris since May 22, 1724; the nineteenth century has not a single one; in the twentieth century, on April 17, 1912, Paris will be just on the limit of totality; but a true total eclipse, of several minutes' duration, will not be seen in the capital of France till August 11, 1999.) Herodotus relates that at the moment of a battle between the Lydians and the Medes a total eclipse of the sun at once stopped the stupefied combatants and put an end to the war. Till recently historians gave various dates for this event, from the year 626 before our era down to the year 583; astronomical calculation, however, proves that this battle took place on May 28 of the year 585 B. C.—FLAMMARION *Popular Astronomy*, bk. ii, ch. 9, p. 182. (A.)

261. ASTRONOMY SUPPOSED EXHAUSTED—*Reenforcement of Physics Has Given It New Youth—The Nature vs. the Movements of the Heavenly Bodies.*—The astronomy so signally promoted by Bessel—the astronomy placed by Comte at the head of the hierarchy of the physical sciences—was the science of the movements of the heavenly bodies. And there were those who began to regard it as a science which, from its very perfection, had ceased to be interesting—whose tale of discoveries was told, and whose further advance must be in the line of minute technical improvements, not of novel and stirring disclosures. But the science of the nature of the heavenly bodies is one only in the beginning of its career. It is full of the audacities, the inconsistencies, the imperfections, the possibilities of youth. It promises everything: it has already performed much; it will doubtless perform much more. The means at its disposal are vast and are being daily augmented.—CLERKE *History of Astronomy*, pt. ii, ch. 1, p. 177. (Bl., 1893.)

262. ASTRONOMY, TRANSFORMATION OF—*A New Epoch—The Manifestation of Universal Life—Peaceful and Glorious Conquests of Science.*—Moreover, astronomy presents us now with one of those radical transformations which form an epoch in the history of the science. It ceases to be a figure and becomes alive. The spectacle of the universe is transfigured before our astonished minds. It is no longer inert bodies rolling in silence in eternal night that the finger of Urania shows us in the depths of the heavens: it is life—life immense, universal, eternal, unfolding itself in waves of harmony out to the inaccessible horizon of an eternal infinite. What marvelous results! What splendors to contemplate! What magnificent fields to traverse! What a series of pictures to admire in these noble and peaceful conquests of the human mind—sublime conquests which cost neither blood nor tears, and where we live in the knowledge of the truth, in the contemplation of the beautiful.—FLAMMARION *Popular Astronomy*, bk. i, ch. 1, p. 3. (A.)

263. ASTRONOMY, UNEXPECTED DEVELOPMENTS IN—*Spectroscope and Camera Supplement Telescope—Man Learns the Nature of Orbs Where He May Never Set Foot.*—The third and last division of celestial science may properly be termed "physical and descriptive astronomy." It seeks to know what the heavenly bodies are in themselves, leaving the How? and the Wherefore? of their movements to be otherwise answered. . . . Inquisitions begun with the telescope have been extended and made effective in unhoped-for directions by the aid of the spectroscope and photographic camera. . . .

The unexpected development of this new physical-celestial science is the leading fact in recent astronomical history. It was out of the regular course of events. In the degree in which it has actually occurred it could certainly not have been foreseen. It was a seizing of the prize by a competitor who had hardly been thought qualified to enter the lists. Orthodox astronomers of the old school looked with a certain contempt upon observers who spent their nights in scrutinizing the faces of the moon and planets rather than in timing their transits; or devoted daylight energies not to reductions and computations, but to counting and measuring spots on the sun. They were regarded as irregular practitioners, to be tolerated perhaps, but certainly not encouraged.—CLERKE *History of Astronomy*, int.. p. 2. (Bl., 1893.)

264. ATHEISM, THE HEART REVOLTS FROM — Our feeling toward atheism goes much deeper than the mere recognition of it as philosophically untrue. The mood in which we condemn it is not at all like the mood in which we reject the corpuscular theory of light. . . . We are wont to look upon atheism with unspeakable horror and loathing. Our moral sense revolts against it no less than our intelligence; and this is because, on its practical side, atheism would remove humanity from its peculiar position in the world, and make it cast in its lot with the grass that withers and the beasts that perish; and thus the rich and varied life of the universe, in all the ages of its wondrous duration, becomes deprived of any such element of purpose as can make it intelligible to us or appeal to our moral sympathies and religious aspirations.—FISKE *Destiny of Man*, ch. 1, p. 13. (H. M. & Co., 1900.)

265. ATHEIST NOT AN IMPOSSIBLE CHARACTER—*Has Become Incapable of Seeing God (Ps. xiv, 1).*—Men tell us sometimes there is no such thing as an atheist. There must be. There are some men to whom it is true that there is no God. They cannot see God because they have no eye. They have only an abortive organ, atrophied by neglect.—DRUMMOND *Natural Law in the Spiritual World*, p. 103. (H. M.)

266. ATMOSPHERE A FATHOMLESS OCEAN—*Perhaps Merging in That of Other Worlds.*—We used to be told that this atmosphere extended forty-five miles above us, but later observation proves its existence at a height of many times this; and a remarkable speculation, which Dr. Hunt strengthens with the great name of Newton, even contemplates it as extending in ever-increasing tenuity until it touches and merges in the atmosphere of other worlds. —LANGLEY *New Astronomy*, ch. 5, p. 136. (H. M. & Co., 1896.)

267. ATMOSPHERE AFFECTED BY VOLCANIC ERUPTION—*Sound-transmission—Waves of Gases Sent Round the World—Air Filled with Rock-dust—Red Sunsets for Two Years.*—The movements which this shock [the eruption of Krakatau in 1883] impressed on the atmosphere were even more remarkable than those which it gave to the sea. The sounds of the explosions were heard for double the distance to which we have any record of their having been audible in previous eruptions. If an eruption of Skaptar in Iceland should be audible at once along our great lakes and upon the Mediterranean, we should have a case of sound-transmission comparable to that in Krakatau in August, 1883. The waves of the air caused by the sudden pressure of the escaping gases rolled around the earth, twice girdling its circumference. Besides the enormous mass of dust which fell upon land and sea within a few hundred miles of the point of explosion, which probably amounted in bulk to as much as twelve cubic miles, an unknown amount of the more finely comminuted rock remained for a long time suspended in the atmosphere and was floated over all parts of the earth's surface, giving to the sky at morning and evening the memorable ruddy glow it presented in the two years following the eruption.—SHALER *Aspects of the Earth*, p. 75. (S., 1900.)

268. ATMOSPHERE A TRAP FOR SUNBEAMS—*Nearness of the Sun Not the Sole Consideration—Saturn and Mercury.*—The cold of outer space can only be estimated, in view of recent observations, as at least four hundred degrees Fahrenheit below zero (mercury freezes at thirty-nine degrees below), and it is the sun which makes up the difference . . . to us, but indirectly, and not in the way that we might naturally think, and have till very lately thought; for our atmosphere has a great deal to do with it beside the direct solar rays, allowing more to come in than to go out, until the temperature rises very much higher than it would were there no air here. Thus, since it is this power in the atmosphere of storing the heat which makes us live, no less than the sun's rays themselves, we see how the temperature of a planet may depend on considerations quite beside its distance from the sun; and when

we discuss the possibility of life in other worlds we shall do well to remember that Saturn may be possibly a warm world, and Mercury conceivably a cold one.—LANGLEY *New Astronomy*, ch. 5, p. 136. (H. M. & Co., 1896.)

269. ATMOSPHERE A VAST HYDRO-ELECTRIC MACHINE—*Friction a General Source of Electricity—Air and Earth Mutually Electrified.*—It has been found that friction is a far more general source of electricity than was at first believed. In fact, electrical phenomena appear to be a constant result of friction, whatever may be the nature of the substances rubbed. Thus it is developed by blowing air over glass. . . . When, now, we consider that the air is always rubbing over the surface of the earth, at times with great rapidity, we shall not be surprised to learn that both bodies are constantly in an electrified condition, the earth being generally charged negatively and the atmosphere positively. Even in fair weather it is always possible to detect the presence of free electricity in the atmosphere; and during a storm, when clouds filled with drops of water are hurried over the surface, grinding against the hills and the trees, or against each other, the atmosphere becomes a vast hydro-electric machine, whose sparks are the lightning and the noise of whose discharges the thunder.—COOKE *Religion and Chemistry*, ch. 2, p. 59. (S., 1891.)

270. ATMOSPHERE, MAGNETIC—*Aura around Electrical Conductor.*—The electrical current is competent to produce effects not merely in its channel or conductor—like water turning a wheel—but to influence bodies entirely outside of that channel. It causes, around its conductor, a peculiar aura or atmosphere like that around the poles of a magnet, but differing from the latter as a whirlwind differs from a steady gale. It converts the conductor into a magnet, which, like other magnets, is capable of influencing magnetic bodies to become magnets. It also converts magnetic bodies, around which the conductor is wound, into magnets; and a bar of iron in this way is given all the properties which it would have were it normally and naturally a magnet, or piece of lodestone.—PARK BENJAMIN *Age of Electricity*, ch. 6, p. 87. (S., 1897.)

271. ——— ——— *Aura or Field of Force around the Poles of a Magnet.*—It appears, therefore, that around the pole of a magnet exists this strange atmosphere—a so-called "field of force," in which exist strains and pulls and pushes as if a host of infinitesimal beings were at work seizing upon the filings, and arranging them to make them accommodate themselves to this new condition of affairs. And the result of it all is, that we recognize seeming lines of force radiating from the pole. It is a wonderful atmosphere, that magnetic field. We have only to move a piece of iron in it, in a peculiar way, to make speech heard miles distant, or to produce the light which is weaker only than the sun in power; and what still stranger things may yet be done no one knows.—PARK BENJAMIN *Age of Electricity*, ch. 6, p. 75. (S., 1897.)

272. ATMOSPHERE OF DEATH—*A Barbarous Experiment—Suffocation of a Dog—Gas Bailed Out Extinguishes Candle.*—Many natural springs of carbonic acid have been discovered, one of which I should like to introduce to your notice. In the neighborhood of the city of Naples there is a cave called the Grotto del Cane, a name given to it for a curious and culpable reason. During one of the eruptions of Vesuvius I paid a visit, in company with two friends, to Naples, and went to see, among the other sights of that wonderful region, the Grotto of the Dog. At a place adjacent we met a guide and some other visitors. At the heels of the guide was a timid little quadruped, which, for the time being, was the victim that gave the cave its name. We could walk into the cave without inconvenience, knowing, at the same time, from the descriptions we had heard and read, that our feet were plunged in a stream of heavy carbonic acid flowing along the bottom of the cave. The poor little dog, much against its will, was brought into the grotto. The stream of carbonic acid was not deep enough to cover the animal; its master, accordingly, pressed its head under the suffocating gas. It struggled for a time, but soon became motionless—apparently lifeless. Taken into the air outside, through a series of convulsions painful to look upon, it returned to life.

The experiment is a barbarous one, and ought not to be tolerated. There are many ways of satisfying the curious without cruelty to the dog. I made the following experiment, which seemed to surprise the bystanders. Placing a burning candle near the bottom of my hat, in the open air outside the cave, I borrowed a cap, and by means of it ladled up the heavy gas. Pouring it from the cap into the hat, the light was quenched as effectually as if water had been poured upon it. Made with glass jars instead of hats, this is a familiar laboratory experiment.—TYNDALL *New Fragments*, p. 338. (A., 1897.)

273. ATMOSPHERE OF THE SUN—*Far Exceeds the Central Mass—Main Body of the Luminary Commonly Unseen.*—What we see of the sun under ordinary circumstances is but a fraction of his total bulk. While by far the greater portion of the solar mass is included within the photosphere—the blazing cloud-layer, which seems to form the sun's true surface, and is the principal source of his light and heat—yet the larger portion of his volume lies without, and constitutes an atmosphere

whose diameter is at least double, and its bulk therefore sevenfold that of the central globe.—YOUNG *The Sun*, ch. 6, p. 191. (A., 1898.)

274. ATMOSPHERE ONCE A SOURCE OF ERROR—*Combustion Not Understood till a Century Ago.*—At first sight chemical processes are frequently very obscure, and one great reason is, that we live in an atmosphere which is a mixture of two invisible aeriform substances, named nitrogen gas and oxygen gas; and these substances, especially the last, are constantly entering as factors into chemical processes without our noticing the circumstance; and, again, the products of such processes, when aeriform, often escape notice by mingling with the great volume of the air. Now, that we are on our guard, we are seldom deceived by the intervention of the atmosphere; but in former times, when the qualities and relations of aeriform bodies were little known, so great was the obscurity thus caused that even the familiar processes of combustion have not been understood until within a century.—COOKE *New Chemistry*, lect. 4, p. 87. (A., 1899.)

275. ATMOSPHERE, POSSIBLE, OF THE MOON—Upon the whole, then, there may (and there should) exist on the moon an atmosphere of feeble density, and probably of a composition very different from ours. Perhaps there may also exist certain liquids, such as water, but in a minimum quantity. If it had no air at all there could not exist a single drop of water, seeing that it is the atmospheric pressure which maintains water in the liquid state, and that without it all water would immediately evaporate. It is possible, after all, that the lunar hemisphere which we never see may be richer in fluids than the visible one. But we see that in any case it would be contrary to the real interpretation of facts to assert, as is too often done, that there is absolutely no atmosphere nor any liquid or fluid on the surface of the moon.—FLAMMARION *Popular Astronomy*, bk. ii, ch. 4, p. 140. (A.)

276. ATMOSPHERE SEPARATED INTO STRATA WOULD DESTROY PITCH OF SOUNDS—*Music Depends on Chemical Law—Diffusion of Gases.*—As the air is now constituted, there is a constancy of pitch, however far sound travels. Any tone once generated remains the same tone until it dies away. Its degree of loudness alters in proportion to the distance of the listener, but the pitch is constant. Were it not, however, for this law of diffusion—were the atmosphere not perfectly homogeneous, and the gases of which it consists even partially separated—there would have been a very different result. The constancy of pitch could no longer have been depended upon. The sound as it traveled would vary its pitch with the ever-varying medium through which it passed, and would arrive at the ear with a tone entirely different from that with which it started. Nor would it require any great difference in the medium to produce a sensible result and to confuse all those delicate differences of pitch on which the whole art of music depends. Whenever, therefore, you may be next enjoying the grand Pastoral Symphony of Beethoven or the Requiem of Mozart, recall the careful adjustment of forces by which alone these magnificent creations of genius were rendered possible, and you cannot fail to recognize in this simple law of Nature the same hand that first strung the lyre and made the soul of man responsive to its seven notes.—COOKE *Religion and Chemistry*, ch. 3, p. 76. (A., 1897.)

277. ATOMS FALL TOGETHER IN COMBUSTION—The burning of charcoal in oxygen is an old experiment, but it has now a significance beyond what it used to have; we now regard the act of combination on the part of the atoms of oxygen and coal as we regard the clashing of a falling weight against the earth. The heat produced in both cases is referable to a common cause. A diamond, which burns in oxygen as a star of white light, glows and burns in consequence of the falling of the atoms of ogygen against it.—TYNDALL *Fragments of Science*, vol. i, ch. 16, p. 372. (A., 1897.)

278. ATOMS, POLARITY OF—*Every Fragment of the Magnet Retains Its Poles.*—What, then, will occur if we break this magnet in two at the center? Shall we obtain two magnets, each with a single pole? No; each half is in itself a perfect magnet, possessing two poles. This may be proved by breaking something of less value than the magnet—the steel of a lady's stays, for example, hardened and magnetized. It acts like the magnet. When broken, each half acts like the whole; and when these parts are again broken we have still the perfect magnet, possessing, as in the first instance, two poles. Push your breaking to its utmost sensible limit, you cannot stop there. The bias derived from observation will infallibly carry you beyond the bourn of the senses, and compel you to regard this thing that we call magnetic polarity as resident in the ultimate particles of the steel. You come to the conclusion that each atom of the magnet is endowed with this polar force. —TYNDALL *Lectures on Light*, lect. 3, p. 97. (A., 1898.)

279. ATOMS, THEIR NUMBER AND WEIGHT—*Heat a Peculiar Form of Atomic Motion.*—Chemistry teaches that heat is directly related to the atoms of matter. Atoms of different substances differ greatly in weight. For instance, the hydrogen atom is the unit of atomic weight, because it is the lightest of all of them. Taking the hydrogen atom as the unit, in round numbers the iron atom weighs as much as 56 atoms

of hydrogen, copper a little over 63, silver 108, gold 197. Heat acts upon matter according to the number of atoms in a given space, and not as its weight. Knowing the relative weights of the atoms of the different metals named, it would be possible to determine by weight the dimensions of different pieces of metal so that they will contain an equal number of atoms. If we take pieces of iron, copper, silver, and gold, each of such weight as that all the pieces will contain the same number of atoms, and subject them to heat till all are raised to the same temperature, it will be found that they have all absorbed practically the same quantity of heat without regard to the different weights of matter. It will be observed that the piece of silver, for instance, will have to weigh nearly twice as much as the iron in order to contain the same number of atoms, but it will absorb the same amount of heat as the piece of iron containing the same number of atoms if both are raised to the same temperature. In view of the above fact it seems that heat acts especially upon the atoms of matter and is a peculiar form of atomic motion. Heat is one kind of motion of the atoms, while electricity may be another form of motion of the same. The two motions may be carried on together.—ELISHA GRAY *Nature's Miracles*, vol. iii, ch. 26, p. 42. (F. H. & H., 1900.)

280. ATOMS THE ULTIMATE ELEMENTS OF CHEMISTRY—*Atomic Evolution.*—If the union of atoms is attended with an ever-increasing evolution of heat as they press together into closer and closer associations, we should naturally expect that the effect of increasing temperature would be to part the atoms; and as we study the phenomena of disassociation we are led to the latest conception of chemical philosophy, that of a condition of disassociated atoms out of which the material universe has been developed. Such isolated atoms are for the present at least the ultimate elements of chemistry, and before reaching this condition all qualities which distinguish substances disappear except only a definite mass whose rhythmic pulsations the spectroscope may reveal. As out of such a primal chaotic condition molecular structures were evolved, the qualities of substances appeared, and the energy of nature was awakened. To discover the laws of this evolution so as to follow its various steps, and be able to predict the results under given conditions, is the future work of chemistry.—COOKE *The New Chemistry*, int., p. 17. (A., 1899.)

281. ATROPHY OF EYES DUE TO DISUSE—*Cave-fishes.*—But there is much in the history of the development of animals that seems to lead to the belief that eventually modifications may be due in part to acts of representatives of the phylum to which they belong. It is difficult to believe that some structural features are simply the result of natural selection operating on chance variations. An application of the doctrine of chances to some such cases appears to be adverse to the conception that they represent the influence of natural selection unaided.

A feature characteristic of most cave animals of widely diverse groups and classes is the atrophy of the eyes, and it seems to be most logical to attribute this to disuse of those organs in remote progenitors, and to assume that the atrophy may have resulted from a failure of nourishment by the nutrient fluid of the organs on account of the loss of functional activity, rather than to selection by nature of forms with successively diminishing eyes. The presence of eyes in most cases certainly would scarcely be an element of disadvantage to animals, and it may be allowable to invoke some other agency than chance selection. We may be justified in postulating that the continuous disuse of the organs would in time react on the nutrition of the parts affected, and finally atrophy or disappearance would result. Like explanation would be applicable to the innumerable cases of atrophy of parts known to the naturalist.—GILL *Proc. Am. Assoc. for the Advancement of Science*, vol. xlvi. (1897.)

282. ATROPHY OF MENTAL POWERS THROUGH DISUSE—*Darwin's Distaste for Poetry.*—There is a passage in Darwin's short autobiography which has been often quoted, and which, for the sake of its bearing on our subject of habit, I must now quote again. Darwin says: "Up to the age of thirty or beyond it, poetry of many kinds gave me great pleasure; and even as a schoolboy I took intense delight in Shakespeare, especially in the historical plays. I have also said that pictures formerly gave me considerable and music very great delight. But now for many years I cannot endure to read a line of poetry. I have tried lately to read Shakespeare, and found it so intolerably dull that it nauseated me. I have also almost lost my taste for pictures or music. . . . My mind seems to have become a kind of machine for grinding general laws out of large collections of facts; but why this should have caused the atrophy of that part of the brain alone, on which the higher tastes depend, I cannot conceive. . . . If I had to live my life again, I would have made a rule to read some poetry and listen to some music at least once every week; for perhaps the parts of my brain now atrophied would thus have been kept alive through use. The loss of these tastes is a loss of happiness, and may possibly be injurious to the intellect, and more probably to the moral character, by enfeebling the emotional part of our nature."—JAMES *Talks to Teachers*, ch. 8, p. 71. (H. H. & Co., 1900.)

283. ATTENTION BRIEF IF VOLUNTARY—*Longer Sustained if Passive—Constant Change of Object—Variety Needed.*—There is no such thing as voluntary attention sustained for more than a few seconds at a time. What is called sustained voluntary attention is a repetition of successive efforts which bring back the topic to the mind. The topic once brought back, if a congenial one, develops; and if its development is interesting it engages the attention passively for a time. . . . This passive interest may be short or long. As soon as it flags, the attention is diverted by some irrelevant thing, and then a voluntary effort may bring it back to the topic again; and so on, under favorable conditions, for hours together. During all this time, however, note that it is not an identical object in the psychological sense, but a succession of mutually related objects, forming an identical topic only, upon which the attention is fixed. No one can possibly attend continuously to an object that does not change.—JAMES *Psychology*, vol. i, ch. 11, p. 420. (H. H. & Co., 1899.)

284. ATTENTION, FIXATION OF—*The Microscopist's Purposed Blindness.*—The practised microscopist, whilst applying one of his eyes to his instrument, and determinedly giving his whole attention to the visual picture he receives through it, can keep his other eye open without being in the least disturbed by the picture of the objects on the table, which must be formed upon its retina, but which he does not see unless their brightness should make him perceive them.—CARPENTER *Mental Physiology*, ch. 3, p. 135. (A., 1900.)

285. ATTENTION IN LISTENING—*Ability to Fix on Particular Part in a Harmony.*—In the act of listening we are not only distinctly conscious of sounds so faint that they would not excite our notice but for the volitional direction of the attention, but we can single out these from the midst of others by a determined and sustained effort, which may even make us quite unconscious of the rest so long as that effort is kept up. Thus a person with a practised "musical ear" (as it is commonly but erroneously termed, it being not the ear, but the brain, which exerts this power), whilst listening to a piece of music played by a large orchestra, can single out any one part in the harmony and follow it through all its mazes; or can distinguish the sound of the weakest instrument in the whole band and follow its strain through the whole performance. And an experienced conductor will not only distinguish when some instrumentalist is playing out of tune, but will at once single out the offender from the midst of a numerous band.—CARPENTER *Mental Physiology*, ch. 3, p. 137. (A., 1900.)

286. ATTENTION, POWER OF, ATTRIBUTED TO EARTHWORMS—*Apparent Evidence of Mental Preoccupation.*—When a worm is suddenly illuminated and dashes like a rabbit into a burrow—to use the expression employed by a friend—we are at first led to look at the action as a reflex one. The irritation of the cerebral ganglia appears to cause certain muscles to contract in an inevitable manner, independently of the will or consciousness of the animal, as if it were an automaton. But the different effect which a light produced on different occasions, and especially the fact that a worm when in any way employed and in the intervals of such employment, whatever set of muscles and ganglia may then have been brought into play, is often regardless of light, are opposed to the view of the sudden withdrawal being a simple reflex action. With the higher animals, when close attention to some object leads to the disregard of the impressions which other objects must be producing on them, we attribute this to their attention being then absorbed; and attention implies the presence of a mind. Every sportsman knows that he can approach animals whilst they are grazing, fighting, or courting, much more easily than at other times. The state, also, of the nervous system of the higher animals differs much at different times; for instance, a horse is much more readily startled at one time than at another. The comparison here implied between the actions of one of the higher animals and of one so low in the scale as an earthworm may appear far-fetched, for we thus attribute to the worm attention and some mental power: nevertheless I can see no reason to doubt the justice of the comparison.—DARWIN *Formation of Vegetable Mould*, ch. 1, p. 7. (Hum., 1887.)

287. ATTENUATION OF VIRULENCE OF BACTERIA—*Pasteur's Method—Protection by Weakening the Enemy.*—It was pointed out by some of the pioneer bacteriologists that the function of bacteria suffered under certain circumstances a marked diminution in power. Later workers found that such a change might be artificially produced. Pasteur introduced the first method, which was the simple one of allowing cultures to grow old before subculturing. Obviously a pure culture cannot last forever. To maintain the species in characteristic condition it is necessary frequently to subculture upon fresh media. If this simple operation be postponed as long as possible consistent with vitality, and then performed, it will be found that the subculture is attenuated, *i. e.*, weakened. Another mode is to raise the pure culture to a temperature approaching its thermal death-point. A third way of securing the same end is to place it under disadvantageous external circumstances, for example a too alkaline or too acid medium. A fourth,

but rarely necessary, method is to pass it through the tissues of an insusceptible animal. Thus we see that, whilst the favorable conditions which we have considered afford full scope for the growth and performance of functions of bacteria, we are able by a partial withdrawal of these, short of that ending fatally, to modify the character and strength of bacteria.—NEWMAN *Bacteria*, ch. 1, p. 36. (G. P. P., 1899.)

288. ATTRACTION CONSTANT, HOWEVER LONG RESTRAINED—The day was fading and the deeper glacier pools were shaded by their icy banks. Through the shadowed water needles of ice were darting; all day long the molecules had been kept asunder by the antagonistic heat; their enemy is now withdrawn, and they lock themselves together in a crystalline embrace.—TYNDALL *Hours of Exercise in the Alps*, ch. 6, p. 74. (A., 1898.)

289. AURORA MAY ENVELOP THE EARTH—*Australis Responds to Borealis.*—It would even seem that this simultaneity of the aurora borealis and australis is the rule and not the exception. Data with regard to the southern hemisphere are often wanting, yet we possess an uninterrupted series of eight years of observations taken at Hobart Town in Tasmania, from 1841 to 1848, during which thirty-four auroras were reckoned. Now, every time that an aurora was seen at Hobart Town an aurora borealis was observed in the northern hemisphere; or, at least, if it were daytime in Europe, there were those important magnetic perturbations which accompany polar auroras.

If it be remembered that the presence of the sun above the horizon prevents a given aurora from being seen over half the surface of the globe, and if we remark that, in the cases cited above, the aurora was seen in the whole of that part of the mean latitudes of the globe where it was night at the time of its appearance, it will not seem unreasonable to admit that at certain moments the lights of the double polar aurora may entirely envelop the earth, with the exception of an equatorial zone of a width of about forty degrees.—ANGOT *Aurora Borealis*, ch. 4, p. 55. (A., 1897.)

290. AUTHORITY A HINDRANCE TO INVESTIGATION—*Werner's Pupils Too Eager to Maintain His Views—Travel Needed for Broad Views of the Universe.*—Werner had a great antipathy to the mechanical labor of writing, and, with the exception of a valuable treatise on metalliferous veins, he could never be persuaded to pen more than a few brief memoirs, and those containing no development of his general views. Altho the natural modesty of his disposition was excessive, approaching even to timidity, he indulged in the most bold and sweeping generalizations, and he inspired all his scholars with a most implicit faith in his doctrines. Their admiration of his genius, and the feelings of gratitude and friendship which they all felt for him, were not undeserved; but the supreme authority usurped by him over the opinions of his contemporaries was eventually prejudicial to the progress of the science; so much so as greatly to counterbalance the advantages which it derived from his exertions. If it be true that delivery be the first, second, and third requisite in a popular orator, it is no less certain that to travel is of first, second, and third importance to those who desire to originate just and comprehensive views concerning the structure of our globe. Now Werner had not traveled to distant countries; he had merely explored a small portion of Germany, and conceived, and persuaded others to believe, that the whole surface of our planet, and all the mountain chains in the world, were made after the model of his own province. It became a ruling object of ambition in the minds of his pupils to confirm the generalizations of their great master, and to discover in the most distant parts of the globe his "universal formations," which he supposed had been each in succession simultaneously precipitated over the whole earth from a common menstruum, or "chaotic fluid." It now appears that the Saxon professor had misinterpreted many of the more important appearances even in the immediate neighborhood of Freiberg.—LYELL *Principles of Geology*, bk. i, ch. 4, p. 47. (A., 1854.)

291. AUTHORITY OF MOTHERHOOD—There is at least one authority the rightfulness of which is not a question, but a fact. All men are born of parents. All men, moreover, are born in a condition of utter helplessness and of absolute dependence. . . . It is a dependence arising out of conditions full to overflowing of all the elements to which the sentiment of moral obligation is necessarily and intuitively attached. It is the least and lowest of these elements that at the breasts of its mother an infant first satisfies its hunger and its thirst. Other elements follow in an ascending order. In the arms of its mother it feels the first sense of rest, and the first ideas of refuge and of protection. In the voice of its mother it hears the first expressions of love, and makes the first responses which that love demands. In the smile of its mother it first finds the great gift of laughter. In the eyes of its mother it has its first look into the mirror of another spirit, and feels the answering tides which are stirring within its own. These are but a part of the great claim, accumulating with the hours and days, upon which the authority of a mother rests. And so it comes to pass that the rightfulness of that authority is by the necessities of nature recognized from the first, and when its voice is issued in command, the duty of obedience is felt and known. As a matter of fact, therefore,

and not at all as a matter of question or of doubt, our first conception of duty, or of moral obligation, is necessarily and universally attached to such acts as are in conformity with the injunctions of this first and most indisputable of all authorities.—ARGYLL *Unity of Nature,* ch. 9, p. 210. (Burt.)

292. AUTHORITY USED TO MAINTAIN ERROR—*Dispute over Nature of Light—Conflict of Theories.*—After philosophers had become aware of the manner in which sound was produced and transmitted, analogy led some of them to suppose that light might be produced and transmitted in a somewhat similar manner. And perhaps, in the whole history of science, there was never a question more hotly contested than this one. Sir Isaac Newton . . . supposed light to consist of minute particles, darted out from luminous bodies. Huygens, the contemporary of Newton, found great difficulty in admitting this cannonade of particles; or in realizing that they could shoot with inconceivable velocity through space, and yet not disturb each other. This celebrated man entertained the view that light was produced by vibrations similar to those of sound. Euler supported Huygens. . . .

The authority of Newton bore these men down, and not until a man of genius within these walls took up the subject had the theory of undulation any chance of coping with the rival theory of emission. To Dr. Thomas Young, formerly Professor of Natural Philosophy in the Royal Institution, belongs the honor of stemming this tide of authority, and of establishing, on a safe basis, the undulatory theory of light. Great things have been done in this edifice; but scarcely a greater thing than this.—TYNDALL *Heat a Mode of Motion,* lect. 10, p. 274. (A., 1900.)

293. AUTOMATISM IMPLIES DESIGN—*Mind behind Machine.*—The automatic theory would seem to be one which can least of all dispense with design, since, either in the literal or current sense of the word, undesigned automatism is, as near as may be, a contradiction in terms. As the automaton man constructs manifests the designs of its maker and mover, so the more efficient automata which man did not construct would not legitimately suggest less than human intelligence. And so all adaptations in the animal and vegetable world which irresistibly suggest purpose (in the sense now accepted) would also suggest design, and, under the law of parsimony, claim to be thus interpreted, unless some other hypothesis will better account for the facts.—ASA GRAY *Darwiniana,* art. 13, p. 360. (A., 1889.)

294. AUTOMATISM LABORIOUSLY ACQUIRED—*The Beginner on the Violin.*—"When one begins to play on the violin, to keep him from raising his right elbow in playing, a book is placed under his right armpit, which he is ordered to hold fast by keeping the upper arm tight against his body. The muscular feelings, and feelings of contact connected with the book, provoke an impulse to press it tight. But often it happens that the beginner, whose attention gets absorbed in the production of the notes, lets drop the book. Later, however, this never happens; the faintest sensations of contact suffice to awaken the impulse to keep it in its place, and the attention may be wholly absorbed by the notes and the fingering with the left hand. The simultaneous combination of movements is thus in the first instance conditioned by the facility with which in us, alongside of intellectual processes, processes of inattentive feeling may still go on."—(Schneider, "Der menschliche Wille.")—JAMES *Psychology,* vol. i, ch. 4, p. 119. (H. H. & Co., 1899.)

295. AUTOMATISM OF MUSICIAN—*Muscles Respond Unconsciously to Sight or Sound.*—Thus a musical performer will play a piece which has become familiar by repetition, whilst carrying on an animated conversation, or whilst continuously engrossed by some train of deeply interesting thought; the accustomed sequence of movements being directly prompted by the sight of the notes, or by the remembered succession of the sounds (if the piece is played from memory), aided in both cases by the guiding sensations derived from the muscles themselves. But further, a higher degree of the same "training" (acting on an organism specially fitted to profit by it) enables an accomplished pianist to play a difficult piece of music at sight; the movements of the hands and fingers following so immediately upon the sight of the notes that it seems impossible to believe that any but the very shortest and most direct track can be the channel of the nervous communication through which they are called forth.—CARPENTER *Mental Physiology,* ch. 5, p. 217. (A., 1900.)

296. AUTOMATISM, THEORY OF, DESTROYS RESPONSIBILITY—*Drunkard Held Blameless—Conqueror of Temptation Allowed No Merit.*—On the automatist theory, a drunkard who deserts a comfortable home for the taproom (I make large allowance for those who have uncomfortable homes), who neglects an attached wife and loving children for the society of profligates, and who, with ample means of higher enjoyment, surrenders himself without a struggle to the allurements of sensual pleasure, and at last renders himself amenable to the law by fatal outrage on the patient wife who has long borne with his brutality, is no more a subject of moral reprobation than poor Hartley Coleridge, who, when he strayed from the loving care of his friends, would be found in the parlor of some rural

public house, delighting the rustics with his wonderful stories, and indulging to his heart's content in the unlimited beer which the publican was only too glad to allow him. When, on the other hand, the subject of a strong hereditary alcoholic craving maintains a daily conflict with his tempter, uses every means he can think of to avoid or weaken its seductions, puts forth all his energy in resisting them, and, through occasional failures, comes off on the whole victorious, the consistent automatist can have no other approbation to bestow upon him than that which he would accord to a self-governing steam-engine, or a compensation balance watch.—CARPENTER *Mental Physiology,* pref., p. 42. (A., 1900.)

297. AUTOMATON THEORY AN IMPERTINENCE — My conclusion is that to urge the automaton theory upon us, as it is now urged, on purely a priori and quasi-metaphysical grounds, is an unwarrantable impertinence in the present state of psychology.—JAMES *Psychology,* vol. i, ch. 5, p. 138. (H. H. & Co., 1899.)

298. AVALANCHE OF STONES—*Abasing That Which Is High—Ceaseless Leveling Action of Denuding Forces.*—By this action the hardest and most solid rock-masses are reduced to a state of complete disintegration, certain of their ingredients undergoing decomposition, and the cementing materials which hold their particles together being removed in a state of solution. In the higher regions of the atmosphere this work of rock-disintegration proceeds with the greatest rapidity; for there the chemical action is reenforced by the powerful mechanical action of freezing water. On high mountain peaks the work of breaking up rock-masses goes on at the most rapid rate, and every craggy pinnacle is swathed by the heaps of fragments which have fallen from it. The Alpine traveler justly dreads the continual fusillade of falling rock-fragments which is kept up by the ever-active power of the frost in these higher regions of the atmosphere; and fears lest the vibrations of his footsteps should loosen, from their position of precarious rest, the rapidly accumulating piles of detritus. No mountain peak attains to any very great elevation above the earth's surface, for the higher we rise in the atmosphere the greater is the range of temperature and the more destructive are the effects of the atmospheric water.—JUDD *Volcanoes,* ch. 10, p. 283. (A., 1899.)

299. ——— ——— *Mountainside Raked as by Cannon-shot.*—While we stood pondering here [on the side of the Weisshorn], a deep and confused roar attracted our attention. From a point near the summit of the Weisshorn a rock had been discharged down a dry couloir, raising a cloud of dust at each bump against the mountain. A hundred similar ones were immediately in motion, while the spaces between the larger masses were filled by an innumerable flight of smaller stones. Each of them shook its quantum of dust in the air, until finally the avalanche was enveloped in a cloud. The clatter was stunning, for the collisions were incessant. Black masses of rock emerged here and there from the cloud, and sped through the air like flying fiends. Their motion was not one of translation merely, but they whizzed and vibrated in their flight as if urged by wings. The echoes resounded from side to side, from the Schallenberg to the Weisshorn and back, until finally, after many a deep-sounding thud in the snow, the whole troop came to rest at the bottom of the mountain. This stone avalanche was one of the most extraordinary things I had ever witnessed, and in connection with it I would draw the attention of future climbers of the Weisshorn to the danger which would infallibly beset any attempt to ascend it from this side, except by one of its *arêtes.* At any moment the mountainside may be raked by a fire as deadly as that of cannon.—TYNDALL *Hours of Exercise in the Alps,* ch. 9, p. 110. (A., 1898.)

300. AWAKENING DETERMINED BY INTEREST—*Hearing of One's Own Name.*—The awakening power of sensory impressions is greatly modified by our habitual state of mind in regard to them. Thus most sleepers are awoke by the sound of their own names uttered in a low tone, when it requires a much louder sound of a different description to produce any manifestation of consciousness. The same thing is seen in comatose states, a patient being often found capable of being momentarily aroused by shouting his name into his ear, when no other sound produces the least effect.—CARPENTER *Mental Physiology,* bk. ii, ch. 15, p. 581. (A., 1900.)

301. AWAKENING DUE TO EXPECTANT ATTENTION — But it is not requisite that the sensory impression should be one habitually attended to during the waking hours, for it is generally sufficient to produce the effect, that the attention should have been strongly fixed upon it, previously to the access of the sleep, as one at which the slumberer is to be aroused. Thus the traveler who requires to set forth upon his journey at an early hour in the morning, and has given directions to be called accordingly, is awakened by a gentle tap at the door of his chamber, altho he may have previously slept through a succession of far louder noises with which he had no concern.—CARPENTER *Mental Physiology,* bk. ii, ch. 15, p. 583. (A., 1900.)

302. AX, THE CHIEF WEAPON OF PRIMITIVE MAN—*Labor and Skill in Making of Axes from Stone.*—The ax was preeminently the implement of antiquity. It was used in war and in the chase, as well

as for domestic purposes, and great numbers have been found, especially at Wangen (Lake of Constance) and Concise (Lake of Neufchâtel). With a few exceptions they are small, especially when compared with the magnificent specimens from Denmark; in length they varied from one to six inches, while the cutting edge had generally a width of from fifteen to twenty lines. Flint was sometimes used, and nephrite or jade in a few cases, but serpentine and diorite were the principal materials. Most of the larger settlements were evidently manufacturing places, and many spoiled pieces and half-finished specimens have been found. After having chosen a stone, the first step was to reduce it by blows with a hammer to a suitable size. Then grooves were made artificially, which must have been a very tedious and difficult operation when flint knives, sand, and water were the only available instruments. Having carried the grooves to the required depth, the projecting portions were removed by a skilful blow with a hammer, and the implement was then sharpened and polished on blocks of sandstone.—AVEBURY *Prehistoric Times*, ch. 6, p. 180. (A., 1900.)

303. BACTERIA CAPTURE NITROGEN FOR HIGHER ORGANISMS — *The Nitrifying Bacteria.*—The third group of micro-organisms connected with the soil exist in groups and colonies situated inside the nodules appearing, under certain circumstances, on the rootlets of the pea, bean, and other *Leguminosæ*. It was Hellriegel and Wilfarth who first pointed out that, altho the higher chlorophyllaceous plants could not directly obtain or utilize free nitrogen, some of them at any rate could acquire nitrogen brought into combination under the influence of bacteria. Hellriegel found that the graminaceous, polygonaceous, cruciferous, and other orders depended upon combined nitrogen supplied within the soil, but that the *Leguminosæ* did not depend entirely upon such supplies.—NEWMAN *Bacteria*, ch. 5, p. 163. (G. P. P., 1899.)

304. BACTERIA, UNIVERSAL PRESENCE OF—*In Earth, Air, and Water. Everywhere.*—There are no other plants or animals so universally found in nature as the bacteria. It is this universal presence, together with their great powers of multiplication, which renders them of so much importance in nature. They exist almost everywhere on the surface of the earth. They are in the soil, especially at its surface. . . . They are in all bodies of water, both at the surface and below it. They are found at considerable depths in the ocean. They are in streams of running water in even greater quantity than in standing water.—CONN *Story of Germ Life*, ch. 1, p. 38. (A., 1900.)

305. ——— *Microscopic Organisms Dormant in Dust.*—Wherever on the face of nature there is a lodging-place for dust there will be found bacteria. In most of these localities they are dormant, or at least growing only a little. The bacteria . . . in pure water multiply very little. When dried as dust they are entirely dormant. But each individual bacterium or spore has the potential power of multiplication, and as soon as it by accident falls upon a place where there is food and moisture it will begin to multiply. Everywhere in Nature, then, exists this group of organisms with its almost inconceivable power of multiplication, but a power held in check by lack of food. Furnish them with food and their potential powers become actual.—CONN *Story of Germ Life*, ch. 1, p. 38. (A., 1900.)

306. BACTERIOLOGY, PRACTICAL IMPORTANCE OF—Municipalities are expending public moneys in water analysis, in the examination of milk, in the inspection of cows and dairies, in the bacterial treatment of sewage, and in disinfection and other branches of public health administration. Again, the newly formed National Association for the Prevention of Tuberculosis, our increasing colonial possessions with their tropical diseases, even medical science itself, which is year by year becoming more preventive, make an increasing claim upon public opinion. The successful accomplishment and solution of these questions depend in a measure upon an educated public opinion respecting the elements of bacteriology. Recently it was urged [in the *Contemporary Review*, Nov., 1897] that "the first elements of bacteriology should be shadowed forth in the primary school." This course was advised owing to such knowledge being of value to those engaged in dairying. As we shall point out at a later stage, many of the undesirable changes occurring in milk are due to bacteria, even as the success of the butter and cheese industries depends on the use and control of the fermentative processes due to their action. Much of the uncertainty attending the manufacture of dairy products can only be abolished by the careful application of some knowledge of the flora of milk.—NEWMAN *Bacteria*, int., p. 12. (G. P. P., 1899.)

307. BALANCE OF FORCES ON OUR GLOBE—*The Earth a Delicately Adjusted Machine—Contrast of the Moon.*—In our nearest neighbor among the planets—the moon—the telescope has revealed to us the existence of a globe, in which the internal forces have not been checked and controlled by the operation of any external agencies—for the moon appears to be destitute of both atmosphere and water. Under these circumstances we find its surface, as we might expect, to be composed of rocks which appear to be entirely of igneous origin; the mountain masses, unworn by rain or frost, river or glacier, being of most prodigious dimensions as compared with those of our own globe, while no features at all resembling

valleys, or plains, or alluvial flats are anywhere to be discerned upon the lunar surface. But by the admirable balancing of the external and internal forces on our own globe, the conditions necessary to animal and vegetable existence are almost constantly maintained, and those interruptions of such conditions, produced by hurricanes and floods, by volcanic outbursts and earthquakes, may safely be regarded as the insignificant accidents of what is, on the whole, a very perfectly working piece of machinery.—JUDD *Volcanoes*, ch. 10, p. 305. (A., 1899.)

308. BALANCE OF HAPPINESS IN THE ANIMAL WORLD—On the whole, then, we conclude that the popular idea of the struggle for existence entailing misery and pain on the animal world is the very reverse of the truth. What it really brings about is the maximum of life and of the enjoyment of life with the minimum of suffering and pain. Given the necessity of death and reproduction—and without these there could have been no progressive development of the organic world—and it is difficult even to imagine a system by which a greater balance of happiness could have been secured.—WALLACE *Darwinism*, ch. 2, p. 27. (Hum., 1889.)

309. BARBARIANS OF ANCIENT EUROPE—*Use of Iron Known by Them.*—The soldiers of Brennus were provided with iron swords, and when the armies of Rome brought the civilization of the South into contact with that of the North they found iron already well known to, and in general use among, their new enemies. Nor is there any reason to suppose that arms of bronze were also at that time still in use in the North, for, had this been so, they would certainly have been mentioned by the Roman writers; whereas the description given by Tacitus of the Caledonian weapons shows that in his time the swords used in Scotland were made of iron. Moreover, there are several cases in which large quantities of arms belonging to the Roman period have been found together, and in which the arms and implements are all of iron. This argument is in its very nature cumulative, and cannot therefore be fully developed here.—AVEBURY *Prehistoric Times*, ch. 7, p. 8. (A., 1900.)

310. BARBARISM, NURSERIES OF—*The Steppes of Asia Have Sent Destruction to Europe.*—These Mongolian and Tartar Steppes, which are intersected by numerous mountain chains, separate the ancient and long-civilized races of Tibet and Hindustan from the rude nations of Northern Asia. They have also exerted a manifold influence on the changing destinies of mankind. They have inclined the current of population southward, impeded the intercourse of nations more than the Himalayas, or the Snowy Mountains of Sirinagur and Gorka, and placed permanent limits to the progress of civilization and refinement in a northerly direction.

History cannot, however, regard the plains of Central Asia under the character of obstructive barriers alone. They have frequently proved the means of spreading misery and devastation over the face of the earth. Some of the pastoral tribes inhabiting this steppe—the Mongols, Getæ, Alani, and Usfini—have convulsed the world. If in the course of earlier ages the dawn of civilization spread like the vivifying light of the sun from east to west, so in subsequent ages and from the same quarter have barbarism and rudeness threatened to overcloud Europe.—HUMBOLDT *Views of Nature*, p. 4. (Bell, 1896.)

311. BAROMETER, ETHICAL, THE—*Lessons Taught by Statistics of Crime.*—The statistics of crime within a given period registers how the ethical barometer stands in dry figures. The statistics of the cases brought before the law are facts that cannot be shaken—they speak for themselves.—BASTIAN *Allgemeine Grundzüge der Ethnologie.* (Translated for *Scientific Side-Lights.*)

312. BARRENNESS SELF-PERPETUATING—*Cause and Effect Reciprocal—Clouds Wait Vainly over the Sahara.*—The vertical ascent of currents of air is one of the principal causes of the most important meteorological phenomena. Where a desert or a sandy surface devoid of vegetation is surrounded by a high mountain chain, the sea-wind may be observed driving a dense cloud over the desert, without any precipitation of vapor taking place before it reaches the crest of the mountains. This phenomenon was formerly very unsatisfactorily referred to an attraction supposed to be exercised by the mountain chain on the clouds. The true cause appears to lie in the ascent from the sandy plain of a column of warm air, which prevents the condensation of the vesicles of vapor. The more barren the surface, and the greater the degree of heat acquired by the sand, the higher will be the ascent of the clouds, and the less readily will the vapor be precipitated. Over the declivities of mountains these causes cease. The play of the vertical column of air is there weaker; the clouds sink, and their disintegration is effected by a cooler stratum of air. Thus deficiency of rain and absence of vegetation in the desert stand in a reciprocal action to one another. It does not rain because the barren and bare surface of sand becomes more strongly heated and radiates more heat; and the desert is not converted into a steppe or grassy plain because without water no organic development is possible.—HUMBOLDT *Views of Nature*, p. 266. (Bell, 1896.)

313. BASKET-MAKING OF PRIMITIVE PEOPLES—There are no savages on earth so rude that they have no form of basketry. The birds and beasts are basket-makers, and

some fishes construct for themselves little retreats where they may hide. Long before the fire-maker, the potter, or even the cook, came the mothers of the Fates, spinning threads, drawing them out, and cutting them off. Coarse basketry or matting is found charred in very ancient sepulchers.—MASON *Woman's Share in Primitive Culture,* ch. 3, p. 42. (A., 1894.)

314. BAS-RELIEFS OF NINEVEH—*Ancient Scenes Preserved—Gigantic Stature Given to Kings and Heroes.*—In the British Museum the alabaster bas-reliefs that adorned the palace courts of Nineveh give a wonderfully clear idea of what Assyrian life was like, how the king rode in his chariot, or let fly his arrows at the lion at bay, or walked with the state umbrella held over his head; how the soldiers swam the rivers on blown skins and the storming party scaled the fortress, while the archers shot down among them from the battlements, and the impaled captives hung in rows full in view outside the walls. But in such scenes proportion did not much matter if only the meaning were conveyed. It did not seem artistically absurd to the Assyrians to make archers so big that two fill a whole parapet; nor did the Egyptians feel the comic impression made on our modern minds by the gigantic figure of the king striding half across the battle-field and grasping a dozen pigmy barbarians at a grip, to slash their heads off with one sweep of his mighty falchion.—TYLOR *Anthropology,* ch. 12, p. 302. (A., 1899.)

315. BEAM OF LIGHT IN DARKNESS—*Gifted Men of Middle Ages—Rapid Spread of Investigation Once Started.*—The germ of those events which have imparted any strongly marked progressive movement to the human mind may be traced deeply rooted in the track of preceding ages. It does not lie in the destinies of mankind that all should equally experience mental obscuration. A principle of preservation fosters the eternal vital process of advancing reason. The Age of Columbus attained the object of its destination so rapidly because a track of fruitful germs had already been cast abroad by a number of highly gifted men, who formed, as it were, a lengthened beam of light amid the darkness of the Middle Ages. One single century—the thirteenth—shows us Roger Bacon, Nicolaus Scotus, Albertus Magnus, and Vincentius of Beauvais. The mental activity, once awakened, was soon followed by an extension of geographical knowledge. When Diego Ribero returned, in the year 1525, from the geographical and astronomical congress which had been held at the Puente de Caya, near Yelves, for the purpose of settling the contentions that had arisen regarding the boundaries of the two empires of the Portuguese and the Spaniards, the outlines of the new continent had been already laid down from Terra del Fuego to the coasts of Labrador. . . . The emulous enterprise of the Spaniards, English, and Portuguese, directed to one and the same object, was then so great that fifty years sufficed to determine the external configuration or the general direction of the coasts of the countries in the western hemisphere.—HUMBOLDT *Cosmos,* vol. ii, pt. ii, p. 229. (H., 1891.)

316. BEAUTIES OF NATURE NEGLECTED BY ROMANS—No description has been transmitted to us from antiquity of the eternal snow of the Alps reddened by the evening glow or the morning dawn, of the beauty of the blue ice of the glaciers, or of the sublimity of Swiss natural scenery, altho statesmen and generals, with men of letters in their retinue, continually passed through Helvetia on their road to Gaul. All these travelers think only of complaining of the wretchedness of the roads, and never appear to have paid any attention to the romantic beauty of the scenery through which they passed. . . . Silius Italicus, who died in the time of Trajan, when Switzerland was already considerably cultivated, describes the region of the Alps as a dreary and barren wilderness at the same time that he extols with admiration the rocky ravines of Italy and the woody shores of the Liris.—HUMBOLDT *Cosmos,* vol. ii, pt. i, p. 38. (H., 1897.)

317. BEAUTY AMID DESOLATION—*Fascination of Alaskan Glaciers—Continual Roar of Avalanches.*—The tide-water glaciers of Alaska are the ones that claim the greatest share of admiration from tourists on account of the wonderful coloring and marvelous beauty of their ice-cliffs and the picturesqueness of the floating islands of ice to which they give origin. The approach to a tide-water glacier is usually first made known by the fleet of bergs that dot the water and chill the atmosphere. These become more numerous as one proceeds, and many times completely cover the water before the ice-cliffs from which they came can be seen. Indeed, at times, the floating bergs form an impenetrable pack through which it is impossible for a vessel to advance. The vicinity of a glacier which terminates in the sea is frequently made manifest also by the roar of avalanches, as fresh masses of ice fall from its face and join the fleet of gleaming bergs crowding the adjacent waters. The noise of the falling fragments may be heard many miles, and sounds like distant thunder or the discharge of heavy guns.

When a large tide-water glacier is seen for the first time, the beholder is fascinated by its beauty, especially if it is illuminated by a brilliant sun, and learns a new lesson, for the reason that the scene is so different from the popular idea of the appearance of glaciers, derived principally from the

well-known ice streams of Switzerland.—RUSSELL *Glaciers of North America*, ch. 6, p. 77. (G. & Co., 1897.)

318. ——— ——— *Gorgeous Sunset among Desert Ranges of Utah.*—The unusually clear air of Utah, especially after the winter rains, renders distant mountains remarkably sharp and distinct, particularly when the sun is low in the sky and a strong side-light brings the sharp serrate crests into bold relief and reveals a richness of sculpturing that was before unseen. At such time the colors on the broad deserts, and amid the purple hills and mountains, are more wonderful than artists have ever painted, and exceed anything of the kind witnessed by the dweller of regions where the atmosphere is moist and the native tints of the rock concealed by vegetation. The hills of New England when arrayed in all the gorgeous panoply of autumnal foliage are not more striking than the desert ranges of Utah when ablaze with the reflected glories of the sunset sky. The rich, native colors of the naked rocks are then kindled into glowing fires, and each cañon and rocky gorge is filled with liquid purple, beside which even the imperial dyes would be dull and lusterless. At such times the glories of the hills are mirrored in the dense water of the lake; their duplicate forms appearing in sharp relief on the paler tints of the reflected sky. As the sun sinks behind the far-off mountains, range after range fades through innumerable shades of purple and violet until only their highest battlements catch the fading glory. The lingering twilight brings softer and more mysterious beauties. Ranges and peaks that were concealed by the glare of the noonday sun start into life. Forms that were before unnoticed people the distant plain like a shadowy encampment. At last each remote mountain crest appears as a delicate silhouette, in which all details are lost, drawn in the softest of violet tints on the fading yellow of the sky.—RUSSELL *Lakes of North America*, ch. 4, p. 79. (G. & Co., 1895.)

319. BEAUTY AND FERTILITY OF EARTH DUE TO DESPISED ORGANISMS—*Worms Antedate and Still Supplement the Plow.*—When we behold a wide, turf-covered expanse, we should remember that its smoothness, on which so much of its beauty depends, is mainly due to all the inequalities having been slowly leveled by worms. It is a marvelous reflection that the whole of the superficial mold over any such expanse has passed, and will again pass, every few years through the bodies of worms. The plow is one of the most ancient and most valuable of man's inventions; but long before he existed the land was in fact regularly plowed, and still continues to be thus plowed by earthworms. It may be doubted whether there are many other animals which have played so important a part in the history of the world as have these lowly organized creatures. Some other animals, however, still more lowly organized, namely, corals, have done far more conspicuous work in having constructed innumerable reefs and islands in the great oceans; but these are almost confined to the tropical zones.—DARWIN *Formation of Vegetable Mould*, ch. 7, p. 91. (Hum., 1887.)

320. BEAUTY AND HARMONY EXIST ONLY IN THE SOUL—*The World vs. Man's Interpretation of It.*—Out in the external world surrounding us there exists neither sound nor song, neither noise nor quiet, but only periodical or fitful vibrating motion, or rest.

The most glorious music, the most inspired speech is nothing there, absolutely nothing except a wild, meaningless surf of sound-waves, a purely mechanical, grossly material movement of bodies that produce sound, and of particles of air that conduct it. Not until it reaches the purely subjective sphere of the sensation of hearing does the new, beautiful, and significant world come into being; but it exists nowhere except within ourselves, and only for us. It has absolutely no existence elsewhere.—CZERNAK *Vorlesung über das Ohr und das Hören.* (Translated for *Scientific Side-Lights.*)

321. BEAUTY AND MAJESTY COMBINED IN PALM—*Aspiring Upward Reach of Its Leaves.*—The direction of the leaves, together with the lofty stem, gives to the palms their character of high majesty. It is a characteristic of the physiognomical beauty of the palm that its leaves are directed aspiringly upwards. . . . Nature seems to have accumulated all the beauties of form in the Jagua palm, which, intermingled with the Cucurito or Vadgihai, whose stem rises to a height of 80 or even more than 100 feet, crowns the granite rocks at the cataracts of Atures and Maypures, and which we also occasionally saw on the lonely banks of the Cassiquiare. Their smooth and slender stems rise to a height of from 64 to 75 feet, projecting like a colonnade above the dense mass of the surrounding foliage.—HUMBOLDT *Views of Nature*, p. 301. (Bell, 96.)

322. ——— ——— *Height of Its Pillar-like Stem.*—Palms [are] the loftiest and most stately of all vegetable forms. To these, above all other trees, the prize of beauty has always been awarded by every nation; and it was from the Asiatic palm-world, or the adjacent countries, that human civilization sent forth the first rays of its early dawn. Marked with rings, and not unfrequently armed with thorns, the tall and slender shaft of this graceful tree rears on high its crown of shining, fan-like, or pinnated leaves, which are often curled like those of some gramineæ. Smooth stems of

the palm, which I carefully measured, rose to a height of 190 feet. The palm diminishes in size and beauty as it recedes from the equatorial towards the temperate zones. —HUMBOLDT *Views of Nature*, p. 223. (Bell, 1896.)

323. BEAUTY AND SUBLIMITY INACCESSIBLE AND BARREN—*Antarctic Ice-capped Continent.*—From about latitude 70° to 79° S. he [Sir J. Ross] found comparatively open water, and sailed along near the coast of a great mass of land, on which, however, it was impossible to set foot. Its shores were everywhere covered with ice projecting into the sea. A thick mass of ice capped the whole region, and bare rock was only seen where precipices rose high above the water. Mile after mile this unbroken rampart, often rising to a height of from two to three hundred feet, presented a hopeless barrier to the explorers. It evidently indicates the margin of a large and mountainous mass of land, perhaps of an Antarctic continent. From the top of the ice-cliff the dazzling white surface sloped up towards a range "whose lofty peaks, perfectly covered with eternal snow, rose to elevations varying from seven to ten thousand feet above the level of the ocean. The glaciers that filled their intervening valleys, and which descended from near the mountain summits, projected in many places several miles into the sea, and terminated in lofty perpendicular cliffs. In a few places the rocks broke through their icy covering, by which alone we could be assured that land formed the nucleus of this, to appearance, enormous iceberg."—BONNEY *Ice-work Present and Past*, pt. i, ch. 2, p. 57. (A., 1896.)

324. BEAUTY AN END IN NATURE—*Elaborate and Multiplied Ornament—Human Impulses Not Out of Harmony with Divine Intelligence.*—It would be to doubt the evidence of our senses and of our reason, or else to assume hypotheses of which there is no proof whatever, if we were to doubt that mere ornament, mere variety, are as much an end and aim in the workshop of Nature as they are known to be in the workshop of the goldsmith and the jeweler. Why should they not? The love and desire of these is universal in the mind of man. It is seen not more distinctly in the highest forms of civilized art than in the habits of the rudest savage, who covers with elaborate carving the handle of his war-club, or the prow of his canoe. Is it likely that this universal aim and purpose of the mind of man should be wholly without relation to the aims and purposes of his Creator? He that formed the eye to see beauty, shall he not see it? He that gave the human hand its cunning to work for beauty, shall his hand never work for it? How, then, shall we account for all the beauty of the world—for the careful provision made for it where it is only the secondary object, not the first?—ARGYLL *Reign of Law*, ch. 14, p. 114. (Burt.)

325. ——— ——— *Gorgeous Coloring of Humming-birds.*—Those who, by special study, have laid their minds alongside the mind of Nature in any of her provinces have generally imparted to them a true sense, so far as it goes, in the interpretation of her mysteries. Let us, then, hear what Mr. Gould says on the beauty of the humming-birds: "The members of most of the genera have certain parts of their plumage fantastically decorated, and in many instances most resplendent in color. My own opinion is that this gorgeous coloring of the humming-birds has been given for the mere purpose of ornament, and for no other purpose of special adaptation in their mode of life; in other words, that ornament and beauty, merely as such, was the end proposed."—ARGYLL *Reign of Law*, ch. 5, p. 137. (Burt.)

326. ——— ——— *Ornament Sought amid Devices for Concealment.*—Even in those cases, for example, where concealment is the main object in view, ornament is never forgotten, but lies, as it were, underneath, carried into effect under the conditions and limitations imposed by the higher law and the more special purpose. Thus, the feathers of the ptarmigan, tho confined by the law of assimilative coloring to a mixture of black and white or gray, have those simple colors disposed in crescent bars and mottlings of beautiful form, even as the lichens which they imitate spread in radiating lines and semicircular ripples over the weather-beaten stones. It is the same with all other birds whose color is the color of their home. For the purpose of concealment, their coloring would be equally effective if it were laid on without order or regularity of form. But this is never done. The required tints are always disposed in patterns, each varying with the genus and the species; varying for the mere sake of variation, and for the beauty which belongs to ornament. And where this purpose is not under the restraint of any other purpose controlling it and keeping it down as it were within comparatively narrow limits, how gorgeous are the results attained! What shall we say of flowers—those banners of the vegetable world which march in such various and splendid triumph before the coming of its fruits? What shall we say of the humming-birds—whose feathers are made to return the light which falls upon them, as if rekindled from intenser fires, and colored with more than all the colors of all the gems?—ARGYLL *Reign of Law*, ch. 4, p. 114. (Burt.)

327. BEAUTY AN END IN THE DIVINE MIND—*Microscopic Perfection in Hidden Rocks.*—There is unity of character in every scale, plate, and fin [among the ichthyolites of the Old Red Sandstone]—

unity such as all men of taste have learned to admire in those three Grecian orders from which the ingenuity of Rome was content to borrow, when it professed to invent—in the masculine Doric, the chaste and graceful Ionic, the exquisitely elegant Corinthian; and yet the unassisted eye fails to discover the finer evidences of this unity: it would seem as if the adorable Architect had brought it out in secret with reference to the Divine idea alone. The artist who sculptured the cherry-stone consigned it to a cabinet, and placed a microscope beside it; the microscopic beauty of these ancient fish was consigned to the twilight depths of a primeval ocean. There is a feeling which at times grows upon the painter and the statuary, as if the perception and lóve of the beautiful had been sublimed into a kind of moral sense. Art comes to be pursued for its own sake; the exquisite conception in the mind, or the elegant and elaborate model, becomes all in all to the worker, and the dread of criticism or the appetite of praise almost nothing. And thus, through the influence of a power somewhat akin to conscience, but whose province is not the just and the good, but the fair, the refined, the exquisite, have works prosecuted in solitude, and never intended for the world, been found fraught with loveliness.—MILLER *Old Red Sandstone*, ch. 5, p. 88. (G. & L., 1851.)

328. ——— ——— *Tyrannous Demand for Perfection Urges Artist On—All Tends to an Ideal.*—Sir Thomas Lawrence, when finishing, with the most consummate care, a picture intended for a semibarbarous, foreign court, was asked why he took so much pains with a piece destined, perhaps, never to come under the eye of a connoisseur. "I cannot help it," he replied; "I do the best I can, unable, through a tyrant feeling that will not brook offense, to do anything less." It would be perhaps overbold to attribute any such overmastering feeling to the Creator; yet certain it is, that among his creatures well-nigh all approximations towards perfection, in the province in which it expatiates, owe their origin to it, and that Deity in all his works is his own rule.—MILLER *Old Red Sandstone*, ch. 5, p. 88. (G. & L., 1851.)

329. BEAUTY DEFIES DEFINITION—The concept of beauty is exceedingly difficult. The effort to construct the notion of beauty always terminates in a logical chaos that bewilders me.—FISCHER *Aesthetik*. (Translated for *Scientific Side-Lights.)*

330. BEAUTY EMBOWERED AMID INHOSPITABLE MOUNTAINS—*Transparency of Mountain Lake.*—This "gem of the Sierra" [Lake Tahoe] is situated at an elevation of 6,200 feet above the sea and is enclosed in all directions by rugged, forest-covered mountain slopes which rise from two to over four thousand feet above its surface. Its expanse is unbroken by islands, and has an area of between 192 to 195 square miles. Its diameter from north to south is 21.6 miles and from east to west 12 miles. On looking down on Lake Tahoe from the surrounding pine-covered heights, one beholds a vast plain of the most wonderful blue that can be imagined. Near shore, where the bottom is of white sand, the waters have an emerald tint, but are so clear that objects far beneath the surface may be readily distinguished. Farther lakeward, the tints change by insensible gradation until the water is a deep blue, unrivaled even by the color of the ocean in its deepest and most remote parts. On calm summer days the sky, with its drifting cloud banks and the rugged mountains with their bare and usually snow-covered summits, are mirrored in the placid waters with such wonderful distinctness and such accuracy of detail, that one is at a loss to tell where the real ends and the duplicate begins. While floating on the lake in a boat, the transparency of the water gives the sensation that one is suspended in mid-air, as every detail on the bottom, fathoms below, is clearly discernible.—RUSSELL *Lakes of North America*, ch. 4, p. 63. (G. & Co., 1895.)

331. BEAUTY ENHANCED BY MYSTERY—*Towers and Castles of Native Rock—Mode of Rock-formation Unknown—Explanation Carries the Difficulty a Step Further Back.*—Every island and rocky crag that rose in Lake Lahontan became a center of accumulation for tufa deposits and was transformed into strange and frequently fantastic shapes by the material precipitated upon it. Now that the waters of the ancient sea have disappeared, these structures stand in the desert valleys like the crumbling ruins of towers, castles, domes, and various other shapes, in keeping with the desolation surrounding them. The finest examples of these water-built structures, some of them a hundred feet or more in height, occur about the border of Pyramid and Winnemucca lakes, or rising from their bottoms and still wholly or in part submerged. The islands in Pyramid Lake are sheathed from base to summit with these deposits and their precipitous sides given a convex outline, owing especially to the vast deposits of dendritic tufa, which was precipitated most abundantly midway up the slopes. . . . When the tufa towers and castle-like piles are broken, the concentric layers of which they are composed are revealed and fill one with wonder at the vast amount of material they contain, as well as attract the eye on account of the delicacy and beauty of their structure. Nowhere else in this country, and, so far as reported, nowhere else in the world, are rocks formed of precipitates from lake waters so magnificently displayed as in the desert valleys of Nevada.

The fascination of the weird and frequently wonderfully impressive scenery of the region formerly submerged beneath the waters of Lake Lahontan, is enhanced, at least to the geologist, by the fact that there is yet an unsolved mystery connected with the tufa deposits that start out as strange, gigantic forms from the desert haze, as one slowly traverses those bitter, alkaline lands. —RUSSELL *Lakes of North America*, ch. 6, p. 111. (G. & Co., 1895.)

332. BEAUTY IN NATURE OBJECTIVE —*Utility Might Dispense with the Beautiful.*—Herculean efforts have been made by modern evolutionists to eliminate altogether the idea of beauty from nature, by theories of sexual selection and the like, and to persuade us that beauty is merely utility in disguise, and even then only an accidental coincidence between our perceptions and certain external things. But in no part of their argument have they more signally failed in accounting for the observed facts, and in no part have they more seriously outraged the common sense and natural taste of men. In point of fact, we have here one of those great correlations belonging to the unity of nature—that indissoluble connection which has been established between the senses and the esthetic sentiments of man and certain things in the external world. But there is more in beauty than this merely anthropological relation. Certain forms, for example, adopted in the skeletons of the lower animals are necessarily beautiful because of their geometrical proportions. Certain styles of coloring are necessarily beautiful because of harmonies and contrasts which depend on the essential properties of the waves of light. Beauty is thus in a great measure independent of the taste of the spectator. It is also independent of mere utility, since, even if we admit that all these combinations of forms, motions, and colors which we call beautiful are also useful, it is easy to perceive that the end could often be attained without the beauty.—DAWSON *Facts and Fancies in Modern Science*, lect. 5, p. 198. (A. B. P. S.)

333. BEAUTY, NATURAL, MOLDS NATION—*Scenery of Greece—Intimate Association of Land and Sea.*—We must not forget that Grecian scenery presents the peculiar charm of an intimate association of land and sea, of shores adorned with vegetation, or picturesquely girt round by rocks gleaming in the light of aerial tints, and of an ocean beautiful in the play of the ever-changing brightness of its deep-toned moving waves. Altho to other nations, sea and land, in the different pursuits of life to which they give rise, appeared as two separate spheres of nature, the Greeks—not only those who inhabited the islands, but also those occupying the southern portion of the continent—enjoyed, almost everywhere, the aspect of the richness and sublime grandeur imparted to the scenery by the contact and mutual influence of the two elements.—HUMBOLDT *Cosmos*, vol. ii, pt. i, p. 25. (H., 1897.)

334. BEAUTY NOT MATCHED BY INTELLECT—*Naturalist Tires of the Exquisite Humming-bird.*—The longer he [the naturalist] observes any one species or individual, the more does he find in it to reward his attention; this is not the case, however, with humming-birds, which possess the avian body, but do not rank mentally with birds. The pleasure one takes in their beauty soon evaporates, and is succeeded by no fresh interest, so monotonous and mechanical are all their actions; and we accordingly find that those who are most familiar with them from personal observation have very little to say about them. A score of humming-birds, of as many distinct species, are less to the student of habits than one little brown-plumaged bird haunting his garden or the rush-bed of a neighboring stream; and, doubtless, for a reason similar to that which makes a lovely human face uninformed by intellect seem less permanently attractive than many a homelier countenance.—HUDSON *Naturalist in La Plata*, ch. 16, p. 211. (C. & H., 1895.)

335. BEAUTY OF CREVASSES IN GLACIERS — *Color Rivals Blue of Ocean Depths.*—The walls of crevasses in névé regions are of the most exquisite turquoise blue, the color deepening below the surface until it seems almost black. The only color in nature that rivals the blue of glacial ice is seen when one looks down into the unfathomable sea. The sides of crevasses are frequently hung with icicles, forming rank on rank of glittering pendants, and fretted and embossed in the most beautiful manner with snow-wreaths, and partially roofed with curtain-like cornices of snow. These details are wrought in silvery white, or in innumerable shades of blue with suggestions of emerald tints. When the sunlight enters the great chasms, their walls seem incrusted with iridescent jewels. The still waters with which many of the gulfs are partially filled reflect every detail of their crystal walls and make their depth seem infinite. No dream of fairy caverns ever exceeded the beauty of these mysterious crypts of the vast cathedral-like amphitheaters of the silent mountains.—RUSSELL *Glaciers of North America*, int., p. 8. (G. & Co., 1897.)

336. BEAUTY OF NATURE SECONDARY IN GREEK POETRY—We find the most attractive scenes of nature introduced in the Homeric songs merely as secondary adjuncts. "The shepherd rejoices in the stillness of night, in the purity of the sky, and in the starry radiance of the vault of heaven; he hears from afar the rush of the mountain torrent, as it pursues its foaming course swollen with the trunks of oaks that have been borne along by its turbid waters"

[Iliad, viii, 555]. The sublime description of the sylvan loneliness of Parnassus, with its somber, thickly wooded and rocky valleys, contrasts with the joyous pictures of the many-fountained poplar groves in the Phæacian island of Scheria, and especially of the land of the Cyclops, "where meadows waving with luxuriant and succulent grass encircle the hills of unpruned vines" [Od., xix, 431]. Pindar, in a dithyrambus in praise of spring, recited at Athens, sings of "the earth covered with new-born flowers, when, in the Argive Nemæa, the first opening shoot of the palm announces the coming of balmy spring." Then he sings of Etna as "the pillar of heaven, the fosterer of enduring snow"; but he quickly turns away from these terrific forms of inanimate nature to celebrate Hiero of Syracuse, and the victorious combats of the Greeks with the mighty race of the Persians.—HUMBOLDT *Cosmos*, vol. ii, pt. i, p. 24. (H., 1897.)

337. BEAUTY OF ORCHIDS—*Innumerable Variety in South America.*—While these plants [of the cactus family] form green oases in the barren desert, the orchidaceæ shed beauty over the most desolate rocky clefts, and the seared and blackened stems of those tropical trees which have been discolored by the action of light. The *Vanilla* form is distinguished by its light-green succulent leaves, and by its variegated and singularly shaped blossoms. Some of the orchidaceous flowers resemble in shape winged insects, while others look like birds, attracted by the fragrance of the honey vessels. An entire life would not suffice to enable an artist, altho limiting himself to the specimens afforded by one circumscribed region, to depict the splendid orchidaceæ which embellish the deep alpine valleys of the Peruvian Andes.—HUMBOLDT *Views of Nature*, p. 220. (Bell, 1896.)

338. BEAUTY OF WILD PLANT FAILS UNDER CULTIVATION—*The Pampas Grass.*—On moist clayey ground flourishes the stately pampa grass, *Gynerium argenteum*, the spears of which often attain a height of eight or nine feet. I have ridden through many leagues of this grass with the feathery spikes high as my head, and often higher. . . . Every one is familiar with it in cultivation; but the garden plant has a sadly decaying, draggled look at all times, and to my mind is often positively ugly, with its dense withering mass of coarse leaves, drooping on the ground, and bundle of spikes, always of the same dead white or dirty cream color. Now color—the various ethereal tints that give a blush to its cloud-like purity—is one of the chief beauties of this grass on its native soil; and travelers who have galloped across the pampas at a season of the year when the spikes are dead, and white as paper or parchment, have certainly missed its greatest charm. The plant is social, and in some places where scarcely any other kind exists it covers large areas with a sea of fleecy white plumes; in late summer, and in autumn, the tints are seen, varying from the most delicate rose, tender and illusive as the blush on the white under-plumage of some gulls, to purple and violaceous. At no time does it look so perfect as in the evening, before and after sunset, when the softened light imparts a mistiness to the crowding plumes, and the traveler cannot help fancying that the tints, which then seem richest, are caught from the level rays of the sun, or reflected from the colored vapors of the afterglow.—HUDSON *Naturalist in La Plata*, ch. 1, p. 6. (C. & H., 1895.)

339. BEAUTY RESULTING FROM INTERFERENCE OF WAVES—*Richly Chased Pattern on Surface of Mercury.*—To the eye of a person conversant with these principles, nothing can be more interesting than the crossing of water ripples. Through their interference the water surface is sometimes shivered into the most beautiful mosaic, trembling rhythmically as if with a kind of visible music. When waves are skilfully generated in a dish of mercury, a strong light thrown upon the shining surface, and reflected on to a screen, reveals the motions of the liquid metal. The shape of the vessel determines the forms of the figures produced. In a circular dish, for example, a disturbance at the center propagates itself as a series of circular waves, which, after reflection, again meet at the center. If the point of disturbance be a little way removed from the center, the interference of the direct and reflected waves produces magnificent chasing. The light reflected from such a surface yields a pattern of extraordinary beauty. When the mercury is slightly struck by a needle-point in a direction concentric with the surface of the vessel, the lines of light run round in mazy coils, interlacing and unraveling themselves in a wonderful manner. When the vessel is square, a splendid checker-work is produced by the crossing of the direct and reflected waves. Thus, in the case of wave-motion, the most ordinary causes give rise to most exquisite effects. The words of your countryman, Emerson, are perfectly applicable here:

"Thou canst not wave thy staff in the air,
Or dip thy paddle in the lake,
But it carves the brow of beauty there,
And the ripples in rimes the oars forsake."

—TYNDALL *Lectures on Light*, lect. 2, p. 54. (A., 1898.)

340. BEAUTY REVEALED BY SUBDUED LIGHT—To one who only beholds the desert land bordering Great Salt Lake in the full glare of the unclouded summer sun, when the peculiar desert haze shrouds the landscape and the strange mirage distorts the outline of the hills, the scenery will no doubt be uninteresting and perhaps

ven repellent. But let him wait until the ool breath from the mountains steals out n the plain and the light becomes less intense, and a transformation will be witessed that will fill his heart with wonder. —RUSSELL *Lakes of North America,* ch. 4, ı. 79. (G. & Co., 1895.)

341. BEES MERCILESS UTILITARIANS—*Individual Sacrificed to Public Welfare.* —Bees are a peculiar people; they know ıo mercy, no gratitude, and grant no pensions. They maintain every one as long as s necessary for the general welfare, but .fter that they make away with him as ıuickly as possible.—GLOCK *Symbolik der Bienen.* (Translated for *Scientific Sidelights.)*

342. BEES VENTILATE THEIR HIVES —*Air-currents Driven by Fanning Wings— Natural Precursor of the Electric Fan.*— Very interesting [says Büchner], and closely onnected with this characteristic of cleaniness, is the conduct of the so-called venilating-bees, which have to take care that n summer or hot weather the air necessary or respiration of the bees in the interior ıf the hive is renewed, and the too high emperature cooled down. The latter preaution is necessary, not only on account ıf the bees working within the hive, to vhom, as already said, a temperature risen ıeyond a certain point would be intolerable, ıut also to guard against the melting or oftening of the wax. The bees charged vith the care of the ventilation divide hemselves into rows and stages in regular ırder through all parts of the hive, and by swift fanning of their wings send little currents of air in such fashion that a powerful tream or change of air passes through all ɔarts of the hive. Other bees stand at the nouth of the hive, which fan in the same vay and considerably accelerate the wind 'rom within. The current of air thus caused s so strong that little bits of paper hung n front of the mouth are rapidly moved. ınd that, according to F. Huber, a lighted natch is extinguished. The wind can be listinctly felt if the hand be held in front. —ROMANES *Animal Intelligence,* ch. 4, p. 191. (A., 1899.)

343. BEGINNING NECESSARILY SUPERNATURAL—If the universe had a beginning, its beginning, by the very conditions of the case, was supernatural: the laws of Nature cannot account for their own origin.—MILL *Positive Philosophy of Auguste Comte,* p. 15. (H. H. & Co., 1887.)

344. BEGINNING OF LIFE SOMEWHERE—*Earth Once Lifeless — Origin Requires Creative Power.*—These different sets of inhabitants who have possessed the earth at successive periods have each a character of their own. The transmutation theory insists that they owe their origin to gradual transformations, and are not, therefore, the result of distinct creative acts. All agree, however, that we arrive at a lower stratum where no trace of life is to be found. Place it where we will: suppose that we are mistaken in thinking that we have reached the beginning of life with the lowest Cambrian deposit; suppose that the first animals preceded this epoch, and that there was an earlier epoch, to be called the Laurentian system, besides many others older still; it is nevertheless true that geology brings us down to a level at which the character of the earth's crust made organic life impossible. At this point, wherever we place it, the origin of animals by development was impossible, because they had no ancestors. This is the true starting-point, and until we have some facts to prove that the power, whatever it was, which originated the first animals has ceased to act, I see no reason for referring the origin of life to any other cause.—AGASSIZ *Journey in Brazil,* ch. 1, p. 43. (H. M. & Co., 1896.)

345. BEGINNING OF LIFE-WORK IN MIDDLE AGE—*Herschel's Great Work Done after His Fortieth Year—Prodigious Labors —Discovery of Uranus.*—He [Herschel] had entered upon his forty-second year when he sent his first paper to the *Philosophical Transactions;* yet during the ensuing thirty-nine years his contributions—many of them elaborate treatises—numbered sixty-nine, forming a series of extraordinary importance to the history of astronomy. As a mere explorer of the heavens his labors were prodigious. He discovered 2,500 nebulæ, 806 double stars, passed the whole firmament in review four several times, counted the stars in 3,400 "gage fields," and executed a photometric classification of the principal stars, founded on an elaborate (and the first systematically conducted) investigation of their relative brightness. He was as careful and patient as he was rapid; spared no time and omitted no precaution to secure accuracy in his observations; yet in one night he would examine, singly and attentively, up to 400 separate objects.

The discovery of Uranus was a mere incident of the scheme he had marked out for himself—a fruit, gathered as it were by the way. It formed, nevertheless, the turning-point in his career. From a star-gazing musician he was at once transformed into an eminent astronomer: he was relieved from the drudgery of a toilsome profession and installed as Royal Astronomer.— CLERKE *History of Astronomy,* ch. 1, p. 15. (Bl., 1893.)

346. BEGINNING, THE, TO BE INTERPRETED BY THE END—*Man the End in Evolution.*—If evolution can be proved to include man, the whole course of evolution and the whole scheme of Nature from that moment assume a new significance. The beginning must then be interpreted from the end, not the end from the beginning. An engineering workshop is unintelligible until

we reach the room where the completed engine stands. Everything culminates in that final product, is contained in it, is explained by it. The evolution of man is also the complement and corrective of all other forms of evolution. From this height only is there a full view, a true perspective, a consistent world.—DRUMMOND *Ascent of Man*, p. 9. (J. P., 1900.)

347. BEGINNINGS OF ASTRONOMY—*Chaldeans the First Astronomers—Careful Observations of the Greeks.*—The Greek astronomers of a later age not only rejected the vague speculations of their ancestors, but proved themselves the most careful observers of their time, and first made astronomy worthy the name of a science. From this Greek astronomy the astronomy of our own time may be considered as coming by direct descent. Still, were it not for the absence of historic records, we could probably trace back both their theories and their system of observation to the plains of Chaldea. The zodiac was mapped out and the constellations named many centuries before they commenced their observations, and these works marked quite an advanced stage of development.—NEWCOMB *Popular Astronomy*, pt. i. int., p. 5. (H., 1899.)

348. ——— ——— *Hipparchus Anticipated Ptolemy—Cycles and Epicycles.*—If we confine ourselves to men whose names and whose labors have come down to us, we must concede to Hipparchus the honor of being the father of astronomy. Not only do his observations of the heavenly bodies appear to have been far more accurate than those of any of his predecessors, but he also determined the laws of the apparent motions of the planets, and prepared tables by which these motions could be calculated. Probably he was the first propounder of the theory of epicyclic motions of the planets, commonly called after the name of his successor, Ptolemy, who lived three centuries later.—NEWCOMB *Popular Astronomy*, pt. i, int., p. 5. (H., 1899.)

349. BEGINNINGS OF SCIENCE—*Superstition Mingled with Real Knowledge.*— . . . A peculiar characteristic of the Tuscans was their inclination for cultivating an intimate connection with certain natural phenomena. Divination, which was the occupation of their equestrian hierarchical caste, gave occasion for a daily observation of the meteorological processes of the atmosphere. The Fulguratores, observers of lightning, occupied themselves in investigating the direction of the lightning, with "drawing it down" and "turning it aside." They carefully distinguished between flashes of lightning from the higher regions of the clouds, and those which Saturn, an earth-god, caused to ascend from below, and which were called Saturnine terrestrial lightning, a distinction which modern physicists have thought worthy of especial attention. Thus were established regular official notices of the occurrence of storms. The *Aquælicium*, the art of discovering springs of waters, which was much practised by the Etruscans, and the drawing forth of water by their *Aquilcges*, indicate a careful investigation of the natural stratification of rocks and of the inequalities of the ground. Diodorus, on this account, extols the Etruscans as industrious inquirers of Nature.—HUMBOLDT *Cosmos*, vol. ii, pt. ii, p. 139. (H., 1897.)

350. BEGINNINGS OF SCULPTURE—*Indian Pipes Molded to Figures of Men and Animals.*—Among the most characteristic specimens of ancient American pottery are the pipes. Some of these are simple bowls, not unlike a common every-day pipe, from which they differ in having generally no stem, the mouth having apparently been applied direct to the bowl. Many are highly ornamented, others are spirited representations of monsters or of animals, such as the beaver, otter, wildcat, elk, bear, wolf, panther, raccoon, opossum, squirrel, manatee, eagle, hawk, heron, owl, buzzard, raven, swallow, parrakeet, duck, grouse, and many others. The most interesting of these, perhaps, is the manatee or lamantin, of which seven representations have been found in the mounds of Ohio. These are no mere rude sculptures, about which there might easily be a mistake, but we are assured that "the truncated head, thick semicircular snout, peculiar nostrils, tumid, furrowed upper lip, singular feet or fins, and remarkable mustaches, are all distinctly marked, and render the recognition of the animal complete." This curious animal is not at present found nearer than the shores of Florida, a thousand miles away.—AVEBURY *Prehistoric Times*, ch. 8, p. 242. (A., 1900.)

351. BEGINNINGS RUDE AND POOR—*Ancestors of Steam-plow, Harvester, and Thresher.*—The ancestor of the steam-plow is the digging-stick of savagery, a branch of a tree sharpened at the end by fire; the progenitors of the steam-harvester and thresher were the stone sickle, the roasting-tray, or, later on, the tribulum.—MASON *Birth of Invention, Address at Centenary of Amer. Patent System, Washington, D. C., 1891.* Proceedings of the Congress, p. 407.

352. BELIEF BEFORE DISCOVERY—*Ross Confident of the Existence of Deep-sea Life.*—In the narrative of the voyage of the "Erebus" and "Terror," published in 1847, Sir James Ross [writes]: "It is well known that marine animals are more susceptible of change of temperature than land animals; indeed they may be isothermally arranged with great accuracy. It will, however, be difficult to get naturalists to believe that these fragile creatures could possibly exist at the depth of nearly 2,000 fathoms below the surface; yet as we know they can bear the pressure of 1,000 fathoms, why

may they not of two? We also know that several of the same species of creatures inhabit the Arctic that we have fished up from great depths in the Antarctic seas. The only way they could get from one pole to the other must have been through the tropics; but the temperature of the sea in those regions is such that they could not exist in it, unless at a depth of nearly 2,000 fathoms. At that depth they might pass from the Arctic to the Antarctic Ocean without a variation of five degrees of temperature; whilst any land animal, at the most favorable season, must experience a difference of fifty degrees, and, if in the winter, no less than 150 degrees of Fahrenheit's thermometer—a sufficient reason why there are neither quadrupeds, nor birds, nor land insects common to both regions."—HICKSON *Fauna of the Deep Sea*, ch. 1, p. 3. (A., 1894.)

353. BELIEF IN A FUTURE LIFE—*Ancient British Islanders.*—The care with which the dead were interred, and the custom [prevalent, but not universal] of burying implements with them, may fairly be regarded as indicating the existence of a belief in the immortality of the soul, and in a material existence after death.

The objects buried with the dead are sometimes numerous, and always interesting. In a large tumulus near Everley, a deposit of burnt bones was "surrounded by a circular wreath of horns of the red-deer"; whilst at a higher level, tho three feet from the summit, was the skeleton of a small dog, the "attendant in the chase, and perhaps the victim in death," of the hunter, whose exquisitely chipped arrow-heads, five in number, were deposited with his ashes.—AVEBURY *Prehistoric Times*, ch. 5, p. 133. (A., 1900.)

354. ——— ——— *Favorite Objects Buried with the Dead—American Indians.*—The remark made by Schoolcraft as regards the American Indians is applicable to many savage tribes. "Nothing that the dead possessed was deemed too valuable to be interred with the body. The most costly dress, arms, ornaments, and implements, are deposited in the grave," which is "placed in the choicest scenic situations—on some crowning hill or gentle eminence in a secluded valley." And the North-American Indians are said, even until within the last few years, to have long cherished a friendly feeling for the French, because, in the time of their supremacy, they had at least this one great merit, that they never disturbed the resting-places of the dead.—AVEBURY *Prehistoric Times*, ch. 5, p. 123. (A., 1900.)

355. BELIEF IN ILLUSIONS OF OTHERS—*Every Man Attributes the Failing to All the Rest.*—Most men are sometimes liable to illusion. Hardly anybody is always consistently sober and rational in his perceptions and beliefs. A momentary fatigue of the nerves, a little mental excitement, a relaxation of the effort of attention by which we continually take our bearings with respect to the real world about us, will produce just the same kind of confusion of reality and phantasm which we observe in the insane. To give but an example: the play of fancy which leads to a detection of animal and other forms in clouds is known to be an occupation of the insane, and is rightly made use of by Shakespeare as a mark of incipient mental aberration in Hamlet; and yet this very same occupation is quite natural to children, and to imaginative adults when they choose to throw the reins on the neck of their fantasy. Our luminous circle of rational perception is surrounded by a misty penumbra of illusion. Common sense itself may be said to admit this, since the greatest stickler for the enlightenment of our age will be found in practise to accuse most of his acquaintance at some time or another of falling into illusion.—SULLY *Illusions*, ch. 1, p. 3. (A., 1897.)

356. BELIEF IN THE UNKNOWABLE A NECESSITY—*Human Personality Inexplicable—Agnosticism Accepts the Mystery.*—Let us ask him [the agnostic] if he can subscribe to the simple creed expressed in the words "I am, I feel, I think." Should he deny these propositions, then there is no basis left on which to argue. Should he admit this much of belief, he has abandoned somewhat of his agnostic position; for it would be easy to show that in even uttering the pronoun "I" he has committed himself to the belief in the unknowable. What is the ego which he admits? Is it the material organism or any one of its organs or parts? or is it something distinct, of which the organism is merely the garment, or outward manifestation? or is the organism itself anything more than a bundle of appearances partially known and scarcely understood by that which calls itself "I"? Who knows? And if our own personality is thus inscrutable, if we can conceive of it neither as identical with the whole or any part of the organism, nor as existing independently of the organism, we should begin our agnosticism here, and decline to utter the pronoun "I" as implying what we cannot know.—DAWSON *Facts and Fancies in Modern Science*, lect. 1, p. 22. (A. B. P. S.)

357. BELIEF NOT FORCED BY WILL—*Created by Action According to Facts: "If Any Man Will Do His Will" (John vii, 17).*—If belief consists in an emotional reaction of the entire man on an object, how can we believe at will? We cannot control our emotions. Truly enough, a man cannot believe at will abruptly. Nature sometimes, and indeed not very infrequently, produces instantaneous conversions for us. She suddenly puts us in an active connec-

tion with objects of which she had till then left us cold. "I realize for the first time," we then say, "what that means!" This happens often with moral propositions. We have often heard them; but now they shoot into our lives; they move us; we feel their living force. Such instantaneous beliefs are truly enough not to be achieved by will. But gradually our will can lead us to the same results by a very simple method: we need only in cold blood act as if the thing in question were real, and keep acting as if it were real, and it will infallibly end by growing into such a connection with our life that it will become real. It will become so knit with habit and emotion that our interests in it will be those which characterize belief. Those to whom "God" and "Duty" are now mere names can make them much more than that if they make a little sacrifice to them every day.—JAMES *Psychology*, vol. ii, ch. 21, p. 321. (H. H. & Co., 1899.)

358. BELIEF THAT NO SUNLIGHT PENETRATES TO DEPTHS OF SEA—Until quite recently, every one agreed that no rays of sunlight could possibly penetrate the sea to a greater depth than a few hundred fathoms. Moseley says that "probably all is dark below 200 fathoms excepting in so far as light is given out by phosphorescent animals," and Wyville Thomson speaks of the "utter darkness of the deep-sea bottom."—HICKSON *Fauna of the Deep Sea*, ch. 2, p. 22. (A., 1894.)

359. BENEFITS CONFERRED BY UNSEEN ORGANISMS—*Their Action Essential to Best Quality of Butter—Bacteria Have Economic Value.*—Cream in ordinary dairies and creameries invariably contains some bacteria, a large number of which are in no sense injurious. Indeed, it is to these bacteria that the ripening and flavoring processes are due. They are perfectly consistent with the production of the best quality of butter. The aroma of butter, as we know, controls in a large measure its price in the market. This aroma is due to the decomposing effect upon the constituents of the butter of the bacteria contained in the cream. In the months of May and June the variety and number of these types of bacteria are decidedly greater than in the winter months, and this explains in part the better quality of the butter at these seasons.—NEWMAN *Bacteria*, ch. 6, p. 215. (G. P. P., 1899.)

360. BENEFITS OF FIRE—*Range of Habitation Widened—Forests Subdued—Canoes Invented—Eskimos and Cave-men.*—Incalculable were the gains that began to flow in upon the first fire-maker, his victory won, its spoils assured. Beneath his tread the globe expanded itself with invitation, for now no longer chained by the sunbeam, he added all the frozen North to his hunting-ground. The Eskimos, according to Professor Dawkins, are the lineal descendants of the cave-men. They are the only American aborigines who have invented a lamp; that simple device has enabled them to conquer and hold an outpost twenty degrees nearer the pole than any other human settlement. Whether the first explorers had caves to fall back upon or not, fire was indispensable to them. A burning brand cleared their paths through forests otherwise impenetrable. When they singled out a tree for their rude carpentry, it was no longer cut down by flints so soon dulled and broken in the process. Fire cunningly applied, to be as cunningly quenched with wet mud, had a sharper and quicker tooth than stone. The tree felled, its trunk was softened and shaped, again by fire, into a canoe for voyages too daring for any raft.—ILES *Flame, Electricity, and the Camera*, ch. 3, p. 24. (D. & McC., 1900.)

361. BENEFITS POSSIBLE IN UNKNOWN FUTURE—*Studies Not To Be Limited to Manifest Demand.*—Let me, firstly, note that those who object to study any subject which they themselves deem unconnected with their own special life and avocation, commit the illogical, and I must say illiberal, mistake of seeking to limit their intellectual progress from a very unreasonable motive and cause. Because such persons consider any particular study of no use, or, what is still more absurd, because they think that it cannot be of any future service to them, the study is rejected. But one is naturally tempted to ask of such persons how, without pretending to possess a special gift of prophecy, they can attain to any knowledge of what will or what will not be of service to them in the future? Who can, in the first place, and as a matter of common-sense detail, reasonably assert that they will never be in any position, or placed in any circumstances, in which a knowledge of the despised branch will not come handy, and even be of valuable nature to them? Human policy in this respect, and especially that which would take upon itself the office of educational censor, and of deciding according to its narrow lights what should or should not be studied in view of the unknown future, is of a very short-sighted kind. The study we prosecute from a liking for it, and in our leisure time, may in the days of the future become the prop and mainstay of our physical and intellectual life, and may unfold sources of pleasure and gratification to us undreamt of until the occasion calls them forth.—ANDREW WILSON *Science-Culture for the Masses*, p. 26. (Hum., 1888.)

362. BENEFITS, RECIPROCAL, OF NATIONS IN SCIENCE—*The Royal Institution of Great Britain Founded by an American—The Smithsonian, by an Englishman.*—At the time of the American Revolution there resided in the town of Rumford, N. H., one Benjamin Thompson, who occupied him-

self in teaching a school. He embraced, as we Americans would say, the wrong side of the question on that occasion—he sided with the king's government. He went to England, became a man of mark, and was knighted. Then he went on the Continent, again distinguished himself by his scientific attainments, again was titled, and this time, in memory of his American home, was called Count Rumford. On his return to London, Count Rumford founded the Royal Institution, and thus to a native American the world owes that establishment which has been glorified by Davy, and Young, and Faraday. Had it not been for Rumford, Davy might have spent his life in filling gas-bags for Dr. Beddoes's patients, and Faraday might have been a bookbinder.

But if Benjamin Thompson, an American, founded the Royal Institution, James Smithson, an Englishman, shortly afterwards founded that noble institution in Washington which bears his name, and which, under the enlightened care of Prof. Henry, has so greatly ministered to the advancement and diffusion of science.—TYNDALL *Lectures on Light*, app. (Draper's Address), p. 235. (A., 1898.)

363. BIBLE THE ONLY STANDARD OF EARLY CHRISTIANS—*Science Measured by Scripture.*—The sufferings of the early Christians, and the extraordinary exaltation of mind which enabled them to triumph over the diabolical tortures to which they were subjected, must have left traces not easily effaced. They scorned the earth, in view of that "building of God, that house not made with hands, eternal in the heavens." The Scriptures which ministered to their spiritual needs were also the measure of their science. When, for example, the celebrated question of Antipodes came to be discussed, the Bible was with many the ultimate court of appeal. Augustine, who flourished A. D. 400, would not deny the rotundity of the earth: but he would deny the possible existence of inhabitants at the other side, "because no such race is recorded in Scripture among the descendants of Adam." Archbishop Boniface was shocked at the assumption of a "world of human beings out of the reach of the means of salvation." Thus reined in, science was not likely to make much progress.—TYNDALL *Fragments of Science*, vol. ii, ch. 9, p. 146. (A., 1897.)

364. BIGOTRY AND SCIENCE—*Descartes Assailed Alike by Catholics and by Protestants.*—Descartes lived and died a good Catholic, and prided himself upon having demonstrated the existence of God and of the soul of man. As a reward for his exertions, his old friends the Jesuits put his works upon the "Index," and called him an atheist, while the Protestant divines of Holland declared him to be both a Jesuit and an atheist. His books narrowly escaped being burned by the hangman; the fate of Vanini was dangled before his eyes; and the misfortunes of Galileo so alarmed him that he well-nigh renounced the pursuits by which the world has so greatly benefited, and was driven into subterfuges and evasions which were not worthy of him.—HUXLEY *Lay Sermons*, serm. 14, p. 342. (G. P. P., 1899.)

365. BINDING A SUBSTITUTE FOR NAILS AND CEMENT—*The Sennit of Oceanica.*—But the savage man's unfailing friend in holding together the parts of his tools is a seizing of some sort. It is so easy, so effective, so readily repaired, and it makes the handle stronger instead of weaker. Hence the Polynesian gentleman, when he goes out to visit or sits in the shade of his own vine and fig-tree, takes along a good quantity of coco-fiber and braids it into sennit. If the reader never saw a roll of sennit, it will pay him to visit the nearest ethnological museum for this sole purpose. The uniformity of the strands, the evenness of the braid, the incomparable winding on the roll or spool, as one might call it, constitute one of the fine arts of Oceanica. But prettier still are the regular, geometrical wrappings of this sennit when it is designed to hold an adz blade and handle in close union. While speaking of this combining substance, it may as well be said that in the building of houses the framework is held together entirely by the braided sennit. The strakes of a boat are united by its means. In short, whatsoever is wrapped for amusement or seriously, and whatsoever is nailed or screwed or pegged or glued in other lands, is in this region united by means of this textile.—MASON *Origins of Invention*, ch. 2, p. 41. (S., 1899.)

366. BIOLOGY, PROBLEMS OF, DEFY MECHANICAL EXPLANATION—I think that the more thoroughly and conscientiously we endeavor to study biological problems, the more we are convinced that even those processes which we have already regarded as explicable by chemical and physical laws are in reality infinitely more complex, and at present defy any attempt at a mechanical explanation.

Thus we have been satisfied to account for the absorption of food from the alimentary canal by the laws of diffusion and osmosis. But we now know that, as regards osmosis, the wall of the intestine does not behave like a dead membrane. We know that the intestinal wall is covered with epithelium, and that every epithelial cell is in itself an organism, a living being with the most complex functions. We know that it takes up food by the active contraction of its protoplasm in the same way as observed in independent naked animal cells.—BUNGE *Text-book of Physiological and Pathological Chemistry*, p. 3. [K. P. & Co.] (Translated for *Scientific Side-Lights.*)

367. BIRD ATTACKED FOR UNUSUAL COLOR—*A Stranger to Its Kind.*—Another instance of misdirected anger in nature, not quite so familiar as that of the bull and red rag, is used as an illustration by one of the prophets: "My heritage is unto me as a speckled bird; the birds round about are against it" [Jer. xii, 9]. I have frequently seen the birds of a thicket gather round some singularly marked accidental visitor, and finally drive him with great anger from the neighborhood. Possibly association comes in a little here, since any bird, even a small one, strikingly colored or marked, might be looked on as a bird of prey.—HUDSON *Naturalist in La Plata,* ch. 12, p. 167. (C. & H., 1895.)

368. BIRDS IN SUDDEN MULTITUDES—*How Explained—Unseen Hosts Ever Passing.*—On the pampas, whenever grasshoppers, mice, frogs, or crickets become excessively abundant we confidently look for the appearance of multitudes of the birds that prey on them. . . . It is plain that these birds have been drawn from over an immense area to one spot; and the question is how have they been drawn? Many large birds possessing great powers of flight are, when not occupied with the business of propagation, incessantly wandering from place to place in search of food. They are not, as a rule, regular migrants, for their wanderings begin and end irrespective of seasons, and where they find abundance they remain the whole year. They fly at a very great height, and traverse immense distances. When the favorite food of any one of these species is plentiful in any particular region all the individuals that discover it remain, and attract to them all of their kind passing overhead. This happens on the pampas with the stork, the short-eared owl, the hooded gull, and the dominican or black-backed gull—the leading species among the feathered nomads: a few first appear like harbingers; these are presently joined by newcomers in considerable numbers, and before long they are in myriads.—HUDSON *Naturalist in La Plata,* ch. 3, p. 64. (C. & H., 1895.)

369. BIRDS KILLED BY SPIDER—*The Gigantic Spider (Mygale) of Brazil—Confirmation of Early Narratives—Lower Life Preying on Higher.*—At Cametá I chanced to verify a fact relating to the habits of a large hairy spider of the genus *Mygale* in a manner worth recording. The species was *M. avicularia,* or one very closely allied to it; the individual was nearly two inches in length of body, but the legs expanded seven inches, and the entire body and legs were covered with coarse gray and reddish hairs. I was attracted by a movement of the monster on a tree-trunk; it was close beneath a deep crevice in the tree; across which was stretched a dense white web. The lower part of the web was broken, and two small birds, finches, were entangled in the pieces; they were about the size of the English siskin, and I judged the two to be male and female. One of them was quite dead; the other lay under the body of the spider not quite dead, and was smeared with the filthy liquor or saliva exuded by the monster. I drove away the spider and took the birds, but the second one soon died. The fact of species of *Mygale* sallying forth at night, mounting trees and sucking the eggs and young of humming-birds, has been recorded long ago by Madame Merian and Palisot de Beauvois; but, in the absence of any confirmation, it has come to be discredited. From the way the fact has been related it would appear that it had been merely derived from the report of natives, and had not been witnessed by the narrators. Count Langsdorff, in his "Expedition into the Interior of Brazil," states that he totally disbelieved the story. I found the circumstances to be quite a novelty to the residents hereabout. The mygales are quite common insects; some species make their cells under stones, others form artistic tunnels in the earth, and some build their dens in the thatch of houses. The natives call them *Aranhas caranguejeiras,* or crab-spiders. The hairs with which they are clothed come off when touched, and cause a peculiar and almost maddening irritation. The first specimen that I killed and prepared was handled incautiously, and I suffered terribly for three days afterward. I think this is not owing to any poisonous quality residing in the hairs, but to their being short and hard, and thus getting into the fine creases of the skin. Some mygales are of immense size. One day I saw the children belonging to an Indian family, who collected for me, with one of these monsters secured by a cord round its waist, by which they were leading it about the house as they would a dog.—BATES *Naturalist on the River Amazon,* ch. 4, p. 655. (Hum., 1880.)

370. BIRDS LOST IN WASTE OF AIR—*Fatal Fascination of Lighthouse.*—It is when fogs and storms obscure the view that birds lose their way. Then they fly much lower, perhaps seeking some landmark, and, should a lighthouse lie in their path, they are often attracted to it in countless numbers. Thousands of birds perish annually by striking these lights during stormy fall weather. In the spring the weather is more settled and fewer birds are killed.—CHAPMAN *Bird-Life,* ch. 4, p. 56. (A., 1900.)

371. BIRDS, MIGRATION OF—*An Almost Universal Law—Mystery in Familiar Things.*—The least observant person who walks even a short distance beyond the range of bricks and mortar cannot fail to notice that in early spring a strange uneasy movement seems to pervade every living thing. . . . But what betokens the arrival of spring even more than the crawling

of snails or the flutter of insects is the arrival of the migratory birds. That they are migratory is to most of us a matter of such familiar knowledge that we no more think of questioning it than we conceive it necessary to doubt the rotundity of the earth or the waning of the moon. We know that certain feathered friends are here during the summer, and it is equally certain that they are absent a few months later, only to appear with the first flowers and the pioneer bees. . . . All summer these little feathered folk revel in the joy of existence. The pair build their nest, rear their young, and disappear, until the observer who was intent six months before in watching their arrival may find a sadder but not less intellectual amusement in noting how one by one they vanish from the woods, the commons, the fields, the gardens, and the riversides, where they had to all appearance established themselves for good.—BROWN *Nature-Studies*, p. 11. (Hum., 1888.)

372. BIRDS' WINGS SELF-ACTING VALVES—*Adjustment to Upward and Downward Strokes.*—But there is another difficulty to be overcome [in flight]—a difficulty opposed by natural laws, and which can only be met by another adjustment, if possible more ingenious and beautiful than the rest. It is obvious that if a bird is to support itself by the downward blow of its wings upon the air, it must at the end of each downward stroke lift the wing upwards again, so as to be ready for the next. But each upward stroke is in danger of neutralizing the effect of the downward stroke. It must be made with equal velocity, and if it required equal force it must produce equal resistance—an equal rebound from the elasticity of the air. If this difficulty were not evaded somehow, flight would be impossible. But it is evaded by two mechanical contrivances, which, as it were, triumph over the laws of aerial resistance by conforming to them. One of these contrivances is, that the upper surface of the wing is made convex, whilst the under surface is concave. The enormous difference which this makes in atmospheric resistance is familiarly known to us by the difference between the effect of the wind on an umbrella which is exposed to it on the under or the upper side. The air which is struck by a concave or hollow surface is gathered up, and prevented from escaping: whereas the air struck by a convex or bulging surface escapes readily on all sides, and comparatively little pressure or resistance is produced. And so, from the convexity of the upper surface of a bird's wing, the upward stroke may be made with comparatively trifling injury to the force gained in the downward blow.

But this is only half of the provision made against a consequence which would be so fatal to the end in view. The other half consists in this—that the feathers of a bird's wing are made to underlap each other, so that in the downward stroke the pressure of the air closes them upwards against each other, and converts the whole series of them into one connected membrane, through which there is no escape; whilst in the upward stroke the same pressure has precisely the reverse effect—it opens the feathers, separates them from each other, and converts each pair of feathers into a self-acting valve, through which the air rushes at every point.—ARGYLL *Reign of Law*, ch. 3, p. 81. (Burt.)

373. BIRTH OF GEOLOGY—*Early Study of the Neptunian or Stratified Rocks.*—In the latter part of the eighteenth century, extensive mining operations in Saxony gave rise to an elaborate investigation of the soil for practical purposes. It was found that the rocks consisted of a succession of materials following each other in regular sequence, some of which were utterly worthless for industrial purposes, while others were exceedingly valuable. . . . But while the workmen wrought at these successive layers of rock to see what they would yield for practical purposes, a man [Werner] was watching their operations who considered the crust of the earth from quite another point of view. . . . From the general character of these rocks, as well as the number of marine shells contained in them, he convinced himself that the whole series, including the coal, . . . the red sandstone, and the *Muschel-Kalk*, had been deposited under the agency of water, and were the work of the ocean.—AGASSIZ *Geological Sketches*, ser. i, ch. 4, p. 113. (H. M. & Co., 1896.)

374. —— —— *Hutton Studies the Plutonic or Igneous Rocks.*—But, in the meantime [compare 373], James Hutton, a Scotch geologist, was looking at phenomena of a like character from a very different point of view. In the neighborhood of Edinburgh, where he lived, was an extensive region of trap-rock—that is, of igneous rock, which had forced itself through the stratified deposits, sometimes spreading in a continuous sheet over large tracts, or splitting them open and filling all the interstices and cracks so formed. Thus he saw igneous rocks not only covering or underlying stratified deposits, but penetrating deep into their structure, forming dikes at right angles with them, and presenting, in short, all the phenomena belonging to volcanic rocks in contact with stratified materials. He again pushed his theory too far, and, inferring from the phenomena immediately about him that heat had been the chief agent in the formation of the earth's crust, he was inclined to believe that the stratified materials also were in part at least due to this cause.—AGASSIZ *Geological Sketches*, ser. i, ch. 4, p. 115. (H. M. & Co., 1896.)

375. BLACKNESS OF ATLANTIC DEPTHS—*Reflection Necessary To Give Color—Solid Particles in Suspension Give the Green Hue to Shoal Water.*—If, then, we render water sufficiently deep to quench all the light, and if from the interior of the water no light reaches the eye, we have the condition necessary to produce blackness. Looked properly down upon there are portions of the Atlantic Ocean to which one would hardly ascribe a trace of color: at the most a tint of dark indigo reaches the eye. The water, in fact, is practically black, and this is an indication both of its depth and purity. But the case is entirely changed when the ocean contains solid particles in a state of mechanical suspension, capable of sending light back to the eye. Throw, for example, a white pebble into the blackest Atlantic water; as it sinks it becomes greener and greener, and, before it disappears, it reaches a vivid blue green. Break such a pebble into fragments, these will behave like the unbroken mass; grind the pebble to powder, every particle will yield its modicum of green; and if the particles be so fine as to remain suspended in the water, the scattered light will be a uniform green. Hence the greenness of shoal water. You go to bed with the black water of the Atlantic around you. You rise in the morning, find it a vivid green, and correctly infer that you are crossing the bank of Newfoundland. Such water is found charged with fine matter in a state of mechanical suspension. The light from the bottom may sometimes come into play, but it is not necessary. The subaqueous foam generated by the screw or paddle-wheels of a steamer also sends forth a vivid green. The foam here furnishes a reflecting surface, the water between the eye and it the absorbing medium. —TYNDALL *Lectures on Light*, lect. 1, p. 35. (A., 1898.)

376. BLINDNESS OF INSTINCT—*Squirrel Burying Nut.*—[The following] instance is given by Dr. H. D. Schmidt, of New Orleans, in the "Transactions of American Neurological Association," vol. i, p. 129 (1875): "I may cite the example of a young squirrel which I had tamed, a number of years ago, when serving in the army, and when I had sufficient leisure and opportunity to study the habits of animals. In the autumn, before the winter sets in, adult squirrels bury as many nuts as they can collect, separately, in the ground. Holding the nut firmly between their teeth, they first scratch a hole in the ground, and, after pointing their ears in all directions to convince themselves that no enemy is near, they ram—the head, with the nut still between the front teeth, serving as a sledge-hammer—the nut into the ground, and then fill up the hole by means of their paws. The whole process is executed with great rapidity, and, as it appeared to me, always with exactly the same movements; in fact, it is done so well that I could never discover the traces of the burial-ground. Now, as regards the young squirrel, which, of course, never had been present at the burial of a nut, I observed that, after having eaten a number of hickory-nuts to appease its appetite, it would take one between its teeth, then sit upright and listen in all directions. Finding all right, it would scratch upon the smooth blanket on which I was playing with it as if to make a hole, then hammer with the nut between its teeth upon the blanket, and finally perform all the motions required to fill up a hole—*in the air;* after which it would jump away, leaving the nut, of course, uncovered."—JAMES *Psychology*, vol. ii, ch. 24, p. 400. (H. H. & Co., 1899.)

377. BLOOD-BROTHERHOOD—*A Symbol of Duty and Truth Owed Only to Kindred.*—In the old days, before there were lawyers and law-books, solemn acts and rights were made plain to all men by picturesque ceremonies suited to lay hold of unlettered minds. Many of these old ceremonies are still kept up and show their meaning as plainly as ever. For example, when two parties wish to make firm peace or friendship, they will go through the ceremony of mixing their blood, so as to make themselves blood-relations. Travelers often now ally themselves in such blood-brotherhood with barbarous tribes; an account of East Africans performing the rite describes the two sitting together on a hide so as to become "of one skin," and then they made little cuts in one another's breasts, tasted the mixed blood, and rubbed it into one another's wounds. Thus we find still going on in the world a compact which Herodotus describes among the ancient Lydians and Scythians, and which is also mentioned in the sagas of the old Northmen and the ancient Irish legends. It would be impossible to put more clearly the great principle of old-world morals, that a man owes friendship not to mankind at large, but only to his own kin, so that to entitle a stranger to kindness and good faith he must become a kinsman by blood. With much the same thought even rude tribes hold that eating and drinking together is a covenant of friendship, for the guest becomes in some sort one of the household, and has to be treated as morally one of the family. This helps to explain the vast importance people everywhere give to the act of dining together.—TYLOR *Anthropology*, ch. 16, p. 423. (A., 1899.)

378. BLOOD, CAUSE OF COLOR OF—*Work of the Red Corpuscles—"The Life of All Flesh Is the Blood" (Lev. xvii, 14).*—When a very thin film of blood is placed under a microscope of sufficient power, we observe that, so far from being a uniformly red fluid, blood is really as colorless as water. This apparent paradox between what we see with the unassisted sight and

what is beheld under the microscope is entirely explained when we discover that the red color of blood is due, not to any inherent property of color in blood as a fluid, but to the enormous number of red particles which float in it. What the microscope enables us to see is the clear liquid between the red particles it bears. To the naked eye, which is unable to distinguish minute objects, and which sees things only in the mass, as it were, blood naturally appears red. In any case, it will take its color from its floating particles.

Some worms have green blood; this is due to the green hue of their blood particles. An oyster or a lobster has colorless blood because it possesses no colored particles at all, but only white or colorless ones. The blood-particles we name "corpuscles"; and in addition to the red ones seen in our blood there are also white corpuscles. The latter are less numerous than the red, and we may calculate that about one white to 400 or 500 red corpuscles is to be taken as a fair or average estimate of their proportion. The red corpuscles of the blood discharge a very important duty in the maintenance of our lives. They are the gas-carriers of the blood. They go forth from the lungs laden with the oxygen we have breathed in; they return to the lungs charged with the carbonic acid gas which we have to breathe out. So far, then, the use and duty of the millions of red particles in our blood are not by any means matters of doubt.—Andrew Wilson *Glimpses of Nature*, ch. 23, p. 74. (Hum., 1892.)

379. BLOOD-LETTING THE ONCE UNIVERSAL CURE — *Patients Reduced To Keep Down Fever.*—The doctrine of vital force entered into the pathological system of changes in irritability. The attempt was made to separate the direct actions of the virus which produce disease, in so far as they depended on the play of blind natural forces, the *symptomata morbi*, from those which brought on the reaction of vital force, the *symptomata reactionis*. The latter were principally seen in inflammation and in fever. It was the function of the physician to observe the strength of this reaction, and to stimulate or moderate it according to circumstances.

The treatment of fever seemed at that time to be the chief point; to be that part of medicine which had a real scientific foundation, and in which the local treatment fell comparatively into the background. The therapeutics of febrile diseases had thereby become very monotonous, altho the means indicated by theory were still abundantly used, and especially blood-letting, which since that time has almost been entirely abandoned.—Helmholtz *Popular Lectures*, lect. 5, p. 217. (L. G. & Co., 1898.)

380. BLOOD POURS TO BRAIN DURING MENTAL ACTIVITY—*Muscles Drained To Supply Higher Life.*—Mosso . . . discovered that the blood-supply to the arms diminished during intellectual activity, and found furthermore that the arterial tension (as shown by the sphygmograph) was increased in these members. . . . The brain itself is an excessively vascular organ, a sponge full of blood, in fact; and another of Mosso's inventions showed that when less blood went to the arms, more went to the head. The subject to be observed lay on a delicately balanced table which could tip downward either at the head or at the foot if the weight of either end were increased. The moment emotional or intellectual activity began in the subject, down went the balance at the head-end, in consequence of the redistribution of blood in his system. But the best proof of the immediate afflux of blood to the brain during mental activity is due to Mosso's observations on three persons whose brain had been laid bare by lesion of the skull. By means of apparatus described in his book, this physiologist was enabled to let the brain-pulse record itself directly by a tracing. The intracranial blood-pressure rose immediately whenever the subject was spoken to, or when he began to think actively, as in solving a problem in mental arithmetic.—James *Psychology*, vol. i, ch. 3, p. 97. (H. H. & Co., 1899.)

381. BLOOD, THE AVENGER OF — *Crude Barbaric Justice—Hebrew Limitation of Ancient Custom.*—When in barbaric life fierce passion breaks loose and a man is slain, this rule of vengeance comes into action. How it works as one of the great forces of society may well be seen among the Australians. As Sir George Grey says in his account of it, the holiest duty a native is called on to perform is to avenge the death of his nearest relation. If he left this duty unfulfilled, the old women would taunt him; if he were unmarried, no girl would speak to him; if he had wives, they would leave him; his mother would cry and lament that she had given birth to so degenerate a son, his father would treat him with contempt, and he would be a mark for public scorn. But what is to be done if the murderer escapes, as must in so wild and thinly peopled a country be easy? Native custom goes on the ancient doctrine that the criminal's whole family are responsible; so that when it is known that a man has been slain, and especially when the actual culprit has escaped, his kinsfolk run for their lives; the very children of seven years old know whether they are of kin to the manslayer, and, if so, they are off at once into hiding. Here, then, we come in view of two principles which every student of law should have clearly in his mind in tracing its history up from its lowest stages. In the primitive law of vengeance of blood, he sees society using for the public benefit the instinct of revenge which man has in common with the lower animals; and by hold-

ing the whole family answerable for the deed of one of its members, the public brings the full pressure of family influence to bear on each individual as a means of keeping the peace. No one who sees the working of blood-vengeance can deny its practical reasonableness, and its use in restraining men from violence while there are as yet no judges and executioners. Indeed among all savages and barbarians the avenger of blood, little as he thinks it himself in his wild fury, is doing his part toward saving his people from perishing by deeds of blood.—TYLOR *Anthropology,* ch. 16, p. 414. (A., 1899.)

382. BLOOM AMID DESOLATION—*Alpine Flowers in the Midst of Ice and Snow.*—There are valleys in the Alps far above six thousand feet which have no glaciers, and where perpetual snow is seen only on their northern sides. These contrasts in temperature lead to the most wonderful contrasts in the aspect of the soil; summer and winter lie side by side, and bright flowers look out from the edge of snows that never melt. Where the warm winds prevail there may be sheltered spots at a height of ten or eleven thousand feet, isolated nooks opening southward where the most exquisite flowers bloom in the midst of perpetual snow and ice; and occasionally I have seen a bright little flower with a cap of snow over it that seemed to be its shelter. The flowers give, indeed, a peculiar charm to these high Alpine regions. Occurring often in beds of the same kind, forming green, blue, or yellow patches, they seem nestled close together in sheltered spots, or even in fissures and chasms of the rock, where they gather in dense quantities. Even in the sternest scenery of the Alps some sign of vegetation lingers. I remember to have found a tuft of lichen growing on the only rock which pierced through the ice on the summit of the Jungfrau.—AGASSIZ *Geological Sketches,* ser. i, ch. 8, p. 226. (H. M. & Co., 1896.)

383. BLOSSOMS OF THE FROST—*Hidden Law Binding Water Crystals to the Angle of Sixty Degrees.*—There is hardly a more beautiful and instructive example of this play of molecular force than that furnished by the case of water. You have seen the exquisite fernlike forms produced by the crystallization of a film of water on a cold window-pane. You have also probably noticed the beautiful rosettes tied together by the crystallizing force during the descent of a snow-shower on a very calm day. The slopes and summits of the Alps are loaded in winter with these blossoms of the frost. They vary infinitely in detail of beauty, but the same angular magnitude is preserved throughout: an inflexible power binding spears and spiculæ to the angle of 60°. The common ice of our lakes is also ruled in its deposition by the same angle. You may sometimes see in freezing water small crystals of stellar shapes, each star consisting of six rays, with this angle of 60° between every two of them. This structure may be revealed in ordinary ice. In a sunbeam, or, failing that, in our electric beam, we have an instrument delicate enough to unlock the frozen molecules without disturbing the order of their architecture. Cutting from clear, sound, regularly frozen ice a slab parallel to the planes of freezing, and sending a sunbeam through such a slab, it liquefies internally at special points, round each point a six-petaled liquid flower of exquisite beauty being formed. Crowds of such flowers are thus produced.—TYNDALL *Lectures on Light,* lect. 3, p. 106. (A., 1898.)

384. BLUE OF SKY ARTIFICIALLY PRODUCED—*Light Separates Atoms from Gas*—*Blue of Sky Results.*—Sulfur and oxygen combine to form sulfurous acid gas, two atoms of oxygen and one of sulfur constituting the molecule of sulfurous acid. It has been recently shown that waves of ether issuing from a strong source, such as the sun or the electric light, are competent to shake asunder the atoms of gaseous molecules. A chemist would call this "decomposition" by light; but it behooves us, who are examining the power and function of the imagination, to keep constantly before us the physical images which underlie our terms. Therefore I say, sharply and definitely, that the components of the molecules of sulfurous acid are shaken asunder by the ether-waves. Enclosing sulfurous acid in a suitable vessel, placing it in a dark room, and sending through it a powerful beam of light, we at first see nothing: the vessel containing the gas seems as empty as a vacuum. Soon, however, along the track of the beam a beautiful sky-blue color is observed, which is due to light scattered by the liberated particles of sulfur.—TYNDALL *Fragments of Science,* vol. ii, ch. 8, p. 120. (A., 1897.)

385. BLUNDER ATTRIBUTED TO NATURE—*The Sloth as Characterized by Buffon*—*A Supposed "Defective Monster."*—"The inertia of this animal is not so much due to laziness as to wretchedness; it is the consequence of its faulty structure. . . . Inactivity, stupidity, and even habitual suffering result from its strange and ill-constructed conformation. Having no weapons for attack or defense, no mode of refuge even by burrowing, its only safety is in flight. Confined within the narrowest range, only climbing with difficulty or dragging itself along painfully, never allowing its plaintive voice to be heard except at night, everything about it shows its wretchedness and proclaims it to be one of those defective monsters, those imperfect sketches, which Nature has sometimes formed, and which, having scarcely the faculty of existence,

could only continue for a short time and have since been removed from the catalog of living beings. . . . To regard these imperfect sketches of animal life as being as good as others, to admit final causes for such ill-proportioned creatures, and to find that Nature is as admirable in them as in her finest works, is to take a most narrow view of the world and make our own ideas of finality the tests of Nature's aims."

In this quotation we have a memorable example of the errors into which the greatest thinkers may sometimes fall. It records a rash judgment (with respect to the sloth) which the illustrious zoologist Buffon allowed himself to make, and which he has recorded in the thirteenth volume of his immortal "Natural History."—MIVART *Types of Animal Life*, ch. 9, p. 246. (L. B. & Co., 1893.)

386. BODIES, CELESTIAL, VIEWED AS ABODES OF SENTIENT BEINGS— *General Belief that Other Worlds Are Inhabited.*—In fact, it is in this way that we view all the celestial bodies. We are not contented when studying the sun, for example, with the mere consideration of the wonderful processes taking place upon his surface and around him; but we inquire how these processes are related to his power of supplying our wants, and the wants of all that live upon the earth, by means of the light and heat which he emits. We study our moon in the same spirit; we see that, whether she be herself inhabited or not, she was not created in vain—she rules our tides, she gives us an important tho intermitting supply of light by night, she serves as a measure of time, she helps to guide the seaman over the trackless waves of ocean, and she subserves our wants in a variety of other ways. And it is the same method of viewing the celestial bodies which has led nearly all men to believe in the existence of multitudes of other worlds than ours.—PROCTOR *Expanse of Heaven*, p. 85. (L. G. & Co., 1897.)

387. BODY AND MIND TRAINED IN UNISON BY THE GREEKS — To the Greeks the idea that the human being consists of two halves whose prerogatives are unequal was wholly foreign; they made the equilibrium between the intellectual and the physical life the groundwork of education. As a consequence, even their culture of the physical life was of a character to cultivate the mind. The greatest possible comprehensiveness of exercise, systematically directed, enlivened by music and combat, was calculated to contribute to the elasticity and activity of the body, to endurance in running and in wrestling, and also to bestow a firm, light step, a free, spirited carriage, the freshness of health, and a clear, unshrinking eye; while stimulating the mental power to prudence and manly self-assertion, and to presence of mind; in fact, to become possessed of the kind of virtues that should distinguish the noble and well bred from the low and uncultivated, the free citizen loving his country from those of servile spirit, egoistic, who think of nothing but material gain.—KÜPPERS *Der Apoxyomenos des Lysippos und die griechische Palästre.* (Translated for *Scientific Side-Lights.*)

388. BODY A WONDERFUL CONTRIVANCE OF CREATIVE SKILL—*Not an Object of Contempt.*—I have no wish whatever to exalt unduly the body; I have, if possible, still less desire to degrade the mind; but I do protest, with all the energy I dare use, against the unjust and most unscientific practise of declaring the body vile and despicable, of looking down upon the highest and most wonderful contrivance of creative skill as something of which man dare venture to feel ashamed.—MAUDSLEY *Body and Mind*, lect. 3, p. 95. (A., 1898.)

389. BODY, MEDIEVAL CONTEMPT FOR—*Regarded as "Prison-house" of the Spirit—False Views of Insanity.*—[Under the medieval philosophy] the body was looked down upon with contempt, as vile and despicable, the temple of Satan, the home of the fleshly lusts which war against the soul, and as needing to be vigilantly kept in subjection, to be crucified daily with its affections and lusts. It was the earthly prison-house of the spirit whose pure immortal longings were to get free from it. Such was the monstrous doctrine of the relation of mind and body. What place could a rational theory of insanity have in such an atmosphere of thought and feeling? The conception of it as a disease was impossible: it was ascribed to a supernatural operation, divine or diabolical, as the case might be—was a real possession of the individual by some extrinsic superior power.—MAUDSLEY *Body and Mind*, lect. 4, p. 101. (A., 1898.)

390. BODY OF MAN A MACHINE— *Descartes's Illustration of a Bathing Diana —Mind the Engineer Controlling the Mechanism.*—Thus, as you may have seen in the grottoes and the fountains in royal gardens, the force with which the water issues from its reservoir is sufficient to move various machines, and even to make them play instruments, or pronounce words according to the different disposition of the pipes which lead the water. And, in truth, the nerves of the machine which I am describing may very well be compared to the pipes of these water-works; its muscles and its tendons to the other various engines and springs which seem to move them; its animal spirits to the water which impels them, of which the heart is the fountain; while the cavities of the brain are the central office. Moreover, respiration and other such actions as are natural and usual in the body, and which depend on the course of the spirits, are like the movements of a clock, or of a mill, which may be kept up by the

ordinary flow of the water. The external objects which, by their mere presence, act upon the organs of the senses; and which, by this means, determine the corporal machine to move in many different ways, according as the parts of the brain are arranged, are like the strangers who, entering into some of the grottoes of these waterworks, unconsciously cause the movements which take place in their presence. For they cannot enter without treading upon certain planks so arranged that, for example, if they approach a bathing Diana, they cause her to hide among the reeds; and if they attempt to follow her, they see approaching a Neptune, who threatens them with his trident; or if they try some other way, they cause some monster, who vomits water into their faces, to dart out; or like contrivances, according to the fancy of the engineers who have made them. And lastly, when the rational soul is lodged in this machine, it will have its principal seat in the brain, and will take the place of the engineer, who ought to be in that part of the works with which all the pipes are connected, when he wishes to increase or to slacken, or in some way to alter, their movements.—HUXLEY *Lay Sermons*, serm. 14, p. 322. (G. P. P., 1899.)

391. ——— ——— *Inscrutable Mystery of Life—Personality.*—All investigation goes to show that in a mechanical sense the body of an animal is only a very ingenious and effective machine, by means of which the living inhabitant which controls it can utilize the energy derived from the food taken into the stomach. The body, regarded as a mechanism, is only a food-engine in which the stomach and the lungs stand for the furnace and boiler of a steam-engine, the nervous system for the valve-gear, and the muscles for the cylinder. How the personality within, which wills and acts, is put into relation with this valve-gear, so as to determine the movements of the body it resides in, is the inscrutable mystery of life; the facts in the case, however, being no less facts because inexplicable.—YOUNG *The Sun*, int., p. 3. (A., 1898.)

392. BODY, THE HUMAN, MECHANICAL FUNCTIONS OF—*Involuntary Closing of the Eye.*—Consider what happens when a blow is aimed at the eye. Instantly, and without our knowledge or will, and even against the will, the eyelids close. What is it that happens? A picture of the rapidly advancing fist is made upon the retina at the back of the eye. The retina changes this picture into an affection of a number of the fibers of the optic nerve; the fibers of the optic nerve affect certain parts of the brain; the brain, in consequence, affects those particular fibers of the seventh nerve which go to the orbicular muscle of the eyelids; the change in these nerve-fibers causes the muscular fibers to change their dimensions, so as to become shorter and broader; and the result is the closing of the slit between the two lids round which these fibers are disposed. Here is a pure mechanism, giving rise to a purposive action, and strictly comparable to that by which Descartes supposes his water-work Diana [see BODY OF MAN, 390] to be moved. But we may go further, and inquire whether our volition, in what we term voluntary action, ever plays any other part than that of Descartes's engineer, sitting in his office, and turning this tap or the other, as he wishes to set one or another machine in motion, but exercising no direct influence upon the movements of the whole.—HUXLEY *Lay Sermons*, serm. 14, p. 335. (G. P. P., 1899.)

393. BOMBARDMENT BY MOLECULES—*Expansion and Contraction Explained.*—According to this theory, which is known as the Kinetic Theory of gases, we are to figure the molecules of a gas as flying in straight lines through space, impinging like little projectiles upon each other, and striking against the boundaries of the space they occupy. I place a bladder, half filled with air, under the receiver of the air-pump, and remove the air from the receiver. The bladder swells. According to our present theory, this expansion of the bladder is produced by the shooting of atomic projectiles against its interior surface. When air is admitted into the receiver, the bladder shrivels to its former size; and here we must figure the discharge of the atoms against the outer surface of the bladder, driving the envelope inwards, causing, at the same time, the atoms within to concentrate their fire, until finally the force from within equals that from without, and the envelope remains quiescent. All the impressions, then, which we derive from heated air or vapor are, according to this hypothesis, due to the impact of gaseous molecules. Thus the impression one receives on entering the hot-room of a Turkish bath is caused by the atomic patter there maintained against the surface of the body.—TYNDALL *Heat a Mode of Motion*, lect. 5, p. 118. (A., 1900.)

394. BONDAGE OF FACT—*Science Must Master Details.*—The bondage under which all true science lies to fact—the necessity of groping among the detail of little and common things—this is a hard lesson for the human intellect to learn—conscious as that intellect is of its own great powers—of its own high aims—of its own large capacities of intuitive understanding. But it is a lesson which must be learned. There are no short cuts in Nature. Her results are always attained by method. Her purposes are always worked out by law. So must ours be. For our bodies and our spirits are both parts of the great order of Nature; and our wills can attain no end, and can ac-

complish no design, except through knowledge and through use of the appropriate and appointed means. Nor can those means be ascertained except by careful observation, and as careful reasoning. It is a hard thing to know all the forces which operate even on our own individual minds; and it is a much harder problem to understand the forces which arise out of the complicated conditions of human society.—ARGYLL *Reign of Law,* ch. 7, p. 197. (Burt.)

395. BOW, THE, A PREHISTORIC WEAPON—*Stone Arrow-heads Prove Antiquity.*—However invented, the bow came into use in ages before history. Its arrow is a miniature of the full-sized javelin, and the old stone arrow-heads found in most regions of the world show the existence of the bow and arrow in the Stone Age, tho hardly back to the drift period. The art of feathering the arrow goes back as far as history, and we know not how much further.—TYLOR *Anthropology,* ch. 8, p. 195. (A., 1899.)

396. BRAIN, ACTIVITY OF, PRODUCES LOCAL HEAT—*Anger Really a Hot Passion—Great Strain of Silent Recitation.*—Brain-activity seems accompanied by a local disengagement of heat. . . . Dr. J. S. Lombard . . . found [in more than 60,000 observations] that any intellectual effort, such as computing, composing, reciting poetry silently or aloud, and especially that emotional excitement such as an anger fit, caused a general rise of temperature, which rarely exceeded a degree Fahrenheit. The rise was in most cases more marked in the middle region of the head than elsewhere. Strange to say, it was greater in reciting poetry silently than in reciting it aloud. Dr. Lombard's explanation is that "in internal recitation an additional portion of energy, which in recitation aloud was converted into nervous and muscular force, now appears as heat." I should suggest rather, if we must have a theory, that the surplus of heat in recitation to oneself is due to inhibitory processes which are absent when we recite aloud. . . . The simple central process is to speak when we think; to think silently involves a check in addition.—JAMES *Psychology,* vol. i, ch. 3, p. 99. (H. H. & Co., 1899.)

397. BRAIN BENUMBED BY HEAT—*Effect of Molecular Motion.*—But what is heat, that it should work such changes in moral and intellectual nature? Why are we unable to read "Mill's Logic" or study the "Kritik der reinen Vernunft" with any profit in a Turkish bath? Heat, defined without reference to our sensations, is a kind of motion, as strictly mechanical as the waves of the sea, or as the aerial vibrations which produce sound. The communication of this motion to the molecules of the brain produces the moral and intellectual effects just referred to. Human action is only possible within a narrow zone of temperature. Transgress the limit on one side, and we are torpid by excess; transgress it on the other, and we are torpid by defect. The intellect is in some sense a function of temperature. Thus at noon we were drained of intellectual energy; eight hours later the mind was awake and active, and through her operations was shed that feeling of earnestness and awe which the mystery of the starry heavens ever inspires. Physically considered, however, the intellect of noon differed from that of 8 p. m. simply in the amount of motion possessed by the molecules of the brain.—TYNDALL *Hours of Exercise in the Alps,* ch. 5, p. 61. (A., 1898.)

398. BRAIN, HEMISPHERES OF, SPECIALIZED — *Right-handed People Are Left-brained.*—Most people, in fact, are left-brained, that is, all their delicate and specialized movements are handed over to the charge of the left hemisphere. The ordinary right-handedness for such movements is only a consequence of that fact, a consequence which shows outwardly on account of that extensive decussation of the fibers whereby most of those from the left hemisphere pass to the right half of the body only.—JAMES *Psychology,* vol. i, ch. 2, p. 39. (H. H. & Co., 1899.)

399. BRAIN NOT INVOLVED IN REFLEX ACTION—*Breathing, the Beating of the Heart, etc., Unconscious—The Highest (Cerebral) Force Economized.*—The reflex actions—breathing, the movements of the intestines, the heart's action, winking, etc. —are known to be stimulated through the spinal cord, and its immediate continuations at the base of the brain; they do not involve the cerebral mass. The responding movements in the case of each of them are limited to the work to be done: to the chest, in breathing; to the intestines, in propelling the food; to the muscles of the heart, in pumping the blood. These actions are unaccompanied with feeling. So, in touching the hand of one asleep, we see the hand curl up, or the arm move away. This is called reflex; it is prompted through the lower centers, without lateral diffusion or communication, and it is directed to a single local group of muscles. In such examples, as formerly seen, the limitation is owing to want of force. There are ways open to the brain; but they are not entered at the instance of a very feeble contact. Still, the fact of limitation of range is accompanied by the fact of unconsciousness: an isolated response is our evidence for contraction of the sphere of excitement; and such isolated responses are little, if at all, accompanied with feeling.—BAIN *Mind and Body,* ch. 4, p. 14. (Hum., 1880.)

400. BRAIN OF MAN AND OF APE—*Absolute and Relative Differences.*—So far as I am aware, no human cranium belonging to an adult man has yet been observed with a

less cubical capacity than 62 cubic inches, the smallest cranium observed in any race of men, by Morton, measuring 63 cubic inches; while, on the other hand, the most capacious gorilla skull yet measured has a content of not more than 34½ cubic inches. Let us assume, for simplicity's sake, that the lowest man's skull has twice the capacity of the highest gorilla.

No doubt this is a very striking difference, but it loses much of its apparent systematic value when viewed by the light of certain other equally indubitable facts respecting cranial capacities.

The first of these is, that the difference in the volume of the cranial cavity of different races of mankind is far greater, absolutely, than that between the lowest man and the highest ape, while, relatively, it is about the same. For the largest human skull measured by Morton contained 114 cubic inches—that is to say, had very nearly double the capacity of the smallest, while its absolute preponderance of 52 cubic inches is far greater than that by which the lowest adult male human cranium surpasses the largest of the gorillas ($62 - 34\frac{1}{2} = 27\frac{1}{2}$). Secondly, the adult crania of gorillas which have as yet been measured differ among themselves by nearly one-third, the maximum capacity being 34.5 cubic inches, the minimum 24 cubic inches; and, thirdly, after making all due allowance for difference of size, the cranial capacities of some of the lower apes fall nearly as much, relatively, below those of the higher apes as the latter fall below man.

Thus, even in the important matter of cranial capacity, men differ more widely from one another than they do from the ape, while the lowest apes differ as much, in proportion, from the highest as the latter does from man. The last proposition is still better illustrated by the study of the modifications which other parts of the cranium undergo in the Simian series.—HUXLEY *Man's Place in Nature*, p. 221. (Hum.)

401. ——— ——— *Difference in Weight of Brain.*—It must not be overlooked, however, that there is a very striking difference in absolute mass and weight between the lowest human brain and that of the highest ape—a difference which is all the more remarkable when we recollect that a full-grown gorilla is probably pretty nearly twice as heavy as a Bosjes man, or as many an European woman. It may be doubted whether a healthy human adult brain ever weighed less than thirty-one or two ounces, or that the heaviest gorilla brain has exceeded twenty ounces. This is a very noteworthy circumstance, and doubtless will one day help to furnish an explanation of the great gulf which intervenes between the lowest man and the highest ape in intellectual power.—HUXLEY *Man's Place in Nature*, p. 231. (Hum.)

402. ——— ——— *Enormous Increase in Human Brain.*—We find the most pronounced distinction between man and the anthropoid apes in the size and complexity of his brain. Thus, Professor Huxley tells us that "it may be doubted whether a healthy human adult brain ever weighed less than 31 or 32 ounces, or that the heaviest gorilla brain has exceeded 20 ounces," altho "a full-grown gorilla is probably pretty nearly twice as heavy as a Bosjes man, or as many an European woman." The average human brain, however, weighs 48 or 49 ounces, and if we take the average ape brain at only 2 ounces less than the very largest gorilla's brain, or 18 ounces, we shall see better the enormous increase which has taken place in the brain of man.—WALLACE *Darwinism*, ch. 15, p. 308. (Hum.)

403. BRAIN OF PRIMITIVE MAN HELD THE POSSIBILITIES OF THE FUTURE—The one endowment that this creature [primitive man] possessed, having in it the promise and potency of all future achievements, was the creative spark called invention. The superabundant brain over and above all the amount required for mere animal existence, held in trust the possibilities of the future, and stamped upon man the divine likeness. This naked ignoramus is the father of the clothed philosopher, looking out into infinite space and time and causation.—MASON *The Birth of Invention, Address at Centenary of Amer. Patent System, Washington, D. C., 1891*, (procs.) p. 405.

404. BRAIN, THE ESSENTIAL ORGAN OF KNOWLEDGE—*Results of Changes in.*—The experiences of the body are one of the conditions of the faculty of memory being what it is. And . . . the brain is the part whose experiences are directly concerned. If the nervous communication be cut off between the brain and other parts, the experiences of those other parts are non-existent for the mind. The eye is blind, the ear deaf, the hand insensible and motionless. And conversely, if the brain be injured, consciousness is abolished or altered, even altho every other organ in the body be ready to play its normal part. A blow on the head, a sudden subtraction of blood, the pressure of an apoplectic hemorrhage, may have the first effect; whilst a very few ounces of alcohol or grains of opium or hasheesh, or a whiff of chloroform or nitrous oxid gas, are sure to have the second. The delirium of fever, the altered self of insanity, are all due to foreign matters circulating through the brain, or to pathological changes in that organ's substance.—JAMES *Psychology*, vol. i, ch. 1, p. 4. (H. H. & Co., 1899.)

405. BREAD CONTAINS FEW BACTERIA—*The Universal Food Relatively Pure.*—Bread forms an excellent medium for molds, but unless specially exposed the bacteria in it are few. Waldo and Walsh have,

however, demonstrated that baking does not sterilize the interior of bread. These observers cultivated numerous bacteria from the center of newly baked London loaves. The writer has recently made a series of examinations of the air of several underground bakehouses in central London; but, tho the air was highly impregnated with flour-dust, few bacteria were present. —NEWMAN *Bacteria*, ch. 6, p. 239. (G. P. P., 1899.)

406. BRIGHTNESS THAT ONLY DARKNESS AND GLOOM REVEAL—*Sun's Chromosphere and Corona Seen Only in Eclipse.*—But what a marvelous spectacle is then afforded to all eyes directed to the same point of the sky! In place of the sun appears a black disk, surrounded by a glorious crown of light. In this ethereal crown we see immense rays diverging from the eclipsed sun. Rose-colored flames appear to issue from the lunar screen which masks the god of day. During two minutes, three minutes, four minutes, the astronomer studies this strange frame, rendered visible by the passage of the moon before the radiant disk, while the people, surprised and still silent, seem to await with anxiety the end of a spectacle which they have never seen before and may never see again. Suddenly a jet of light, a shout of pleasure from a thousand throats, announces the return of the joyous sun, still pure, still luminous, still fiery, still faithful.—FLAMMARION *Popular Astronomy*, bk. ii, ch. 9, p. 197. (A.)

407. BRILLIANCY A MEANS OF CONCEALMENT—*The White-headed Fruit-pigeon.*—In some cases the concealment is effected by colors and markings which are so striking and peculiar that no one who had not seen the creature in its native haunts would imagine them to be protective. An example of this is afforded by the banded fruit-pigeon of Timor, whose pure white head and neck, black wings and back, yellow belly, and deeply curved black band across the breast, render it a very handsome and conspicuous bird. Yet this is what Mr. H. O. Forbes says of it: "On the trees the white-headed fruit-pigeon (*Ptilopus cinctus*) sat motionless during the heat of the day in numbers, on well-exposed branches; but it was with the utmost difficulty that I or my sharp-eyed native servant could ever detect them, even in trees where we knew they were sitting." The trees referred to are species of Eucalyptus which abound in Timor. They have whitish or yellowish bark and very open foliage, and it is the intense sunlight casting black curved shadows of one branch upon another, with the white and yellow bark and deep blue sky seen through openings of the foliage, that produces the peculiar combination of colors and shadows to which the colors and markings of this bird have become so closely assimilated.—WALLACE *Darwinism*, ch. 8, p. 136. (Hum., 1889.)

408. BRILLIANCY OF COLOR CHARACTERIZES MALE BIRDS—*Mothers Commonly Protected by Modest Colors.*—The most fundamental characteristic of birds, from our present point of view, is a greater intensity of color in the male. . . . In order that the species may be continued, young birds must be produced, and the female birds have to sit assiduously on their eggs. While doing this they are exposed to observation and attack by the numerous devourers of eggs and birds, and it is of vital importance that they should be protectively colored in all those parts of the body which are exposed during incubation. To secure this end all the bright colors and showy ornaments which decorate the male have not been acquired by the female, who often remains clothed in the sober hues which were probably once common to the whole order to which she belongs.—WALLACE *Darwinism*, ch. 10, p. 187. (Hum., 1889.)

409. BROTHERHOOD OF MAN—*A Growing Conviction and Sentiment of the Human Race.*—"If we would indicate an idea which, throughout the whole course of history, has ever more and more widely extended its empire, or which, more than any other, testifies to the much-contested and still more decidedly misunderstood perfectibility of the whole human race, it is that of establishing our common humanity—of striving to remove the barriers which prejudice and limited views of every kind have erected among men, and to treat all mankind, without reference to religion, nation, or color, as one fraternity, one great community, fitted for the attainment of one object, the unrestrained development of the physical powers. This is the ultimate and highest aim of society, identical with the direction implanted by nature in the mind of man toward the indefinite extension of his existence. He regards the earth in all its limits, and the heavens as far as his eye can scan their bright and starry depths, as inwardly his own, given to him as the objects of his contemplation, and as a field for the development of his energies. Even the child longs to pass the hills or the seas which enclose his narrow home; yet, when his eager steps have borne him beyond those limits, he pines, like the plant, for his native soil; and it is by this touching and beautiful attribute of man—this longing for that which is unknown, and this fond remembrance of that which is lost—that he is spared from an exclusive attachment to the present. Thus deeply rooted in the innermost nature of man, and even enjoined upon him by his highest tendencies, the recognition of the bond of humanity becomes one of the noblest leading principles in the history

of mankind." [Quoted from Wilhelm von Humboldt.]—HUMBOLDT *Cosmos*, vol. i, p. 358. (H., 1897.)

410. BUBBLE AND FROG—*Elementary Law Has No Adaptation to Circumstance.*—Blow bubbles through a tube into the bottom of a pail of water, they will rise to the surface and mingle with the air. Their action may again be poetically interpreted as due to a longing to recombine with the mother-atmosphere above the surface. But if you invert a jar full of water over the pail, they will rise and remain lodged beneath its bottom, shut in from the outer air, altho a slight deflection from their course at the outset, or a redescent towards the rim of the jar when they found their upward course impeded, would easily have set them free. Suppose a living frog in the position in which we placed our bubbles of air, namely, at the bottom of a jar of water. The want of breath will soon make him also long to rejoin the mother-atmosphere, and he will take the shortest path to his end by swimming straight upwards. But if a jar full of water be inverted over him, he will not, like the bubbles, perpetually press his nose against its unyielding roof, but will restlessly explore the neighborhood until by redescending again he has discovered a path round its brim to the goal of his desires.—JAMES *Psychology*, vol. i, ch. 1, p. 7. (H. H. & Co., 1899.)

411. BUILDINGS, ANCIENT, UNDERMINED BY WORMS—*Subsidence and Cracking of Walls, Cause of.*—Worms have played a considerable part in the burial and concealment of several Roman and other old buildings in England; but no doubt the washing down of soil from the neighboring higher lands, and the deposition of dust, have together aided largely in the work of concealment. Dust would be apt to accumulate wherever old broken-down walls projected a little above the then existing surface and thus afforded some shelter. The floors of the old rooms, halls, and passages have generally sunk, partly from the settling of the ground, but chiefly from having been undermined by worms; and the sinking has commonly been greater in the middle than near the walls. The walls themselves, whenever their foundations do not lie at a great depth, have been penetrated and undermined by worms, and have consequently subsided. The unequal subsidence thus caused probably explains the great cracks which may be seen in many ancient walls, as well as their inclination from the perpendicular.—DARWIN *Formation of Vegetable Mould*, ch. 4, p. 68. (Hum., 1887.)

412. BUTTRESSES, NATURAL—*Supporting Roots of the Brazilian Pashiúba—Tree Stands as if on Stilts—Strange Result of Struggle for Life.*—My guide put me ashore in one place to show me the roots of the Pashiúba. These grow above ground, radiating from the trunk many feet above the surface, so that the tree looks as if supported on stilts; and a person can, in old trees, stand upright among the roots with the perpendicular stem wholly above his head. It adds to the singularity of their appearance that these roots, which have the form of straight rods, are studded with stout thorns, while the trunk of the tree is quite smooth. The purpose of this curious arrangement is, perhaps, similar to that of the buttress-roots already described—namely, to recompense the tree by root-growth above the soil for its inability, in consequence of the competition of neighboring roots, to extend it underground. The great amount of moisture and nutriment contained in the atmosphere may also favor these growths.—BATES *Naturalist on the River Amazon*, ch. 5, p. 661. (Hum., 1880.)

413. CALCULATION, ANCIENT, BY PEBBLES—*Language Preserves the Story of Early Arithmetic.*—In Africa, negro traders may be seen at market reckoning with pebbles, and when they come to five, putting them aside in a little heap. In the South Sea Islands it has been noticed that people reckoning, when they came to ten, would not put aside a heap of ten things, but only a single bit of coconut stalk to stand for ten, and then a bigger piece when they wanted to represent ten tens or a hundred. Now to us it is plain that this use of different kinds of markers is unnecessary, but all that the reckoner with little stones or beans has to do is to keep separate his unit-heap, his ten-heap, his hundred-heap, etc. This use of such things as pebbles for "counters," which still survives in England among the ignorant, was so common in the ancient world that the Greek word for reckoning was *psêphizein*, from *psêphos*, a pebble, and the corresponding Latin word was *calculare*, from *calculus*, a pebble, so that our word calculate is a relic of very early arithmetic. —TYLOR *Anthropology*, ch. 13, p. 313. (A., 1899.)

414. CALCULATION VERIFIED—*A Fine Test—Utilizing the Moon—Star-colors Proved Real—Varied Glory in Distant Space.*—It was long thought that at least the more strongly marked colors, in the case of small companion stars, were due merely to contrast. But the supposition that the colors seen in double stars are due to contrast has been in several instances completely disposed of, by so arranging matters that one star only of a pair is seen at a time. This can readily be arranged where the stars are not very close, and in a great number of cases it has been found that the small star, seen alone, was really blue or green or purple, as the case might be. The experiment was in one case tried in the case of a very close pair, in a very interesting way. The star in question is the ruddy

Antares, called also the Scorpion's Heart. This star has a minute green companion, far too close to the red primary star to be seen alone by any arrangement of the telescope. But advantage was taken by an eminent observer of the passage of the moon over this star. In a moment or two the moon hid the larger star, leaving the other shining alone, and then it was seen that the small star was unmistakably green.—PROCTOR *Expanse of Heaven*, pp. 220-221. (L. G. & Co., 1897.)

415. CALM OF NATURE — *Supposed Discord of the Elements Lost in Higher Unity.*—The knowledge of the laws of Nature, whether we can trace them in the alternate ebb and flow of the ocean, in the measured path of comets, or in the mutual attractions of multiple stars, alike increases our sense of the calm of Nature, while the chimera so long cherished by the human mind in its early and intuitive contemplations, the belief in a "discord of the elements," seems gradually to vanish in proportion as science extends her empire.—HUMBOLDT *Cosmos*, vol. i, int., p. 42. (H., 1897.)

416. CALMNESS OF SCIENCE—*Relief from Strife and Discord—Fascination of Botany or Astronomy.*—He therefore, who amid the discordant strife of nations would seek intellectual repose, turns with delight to contemplate the silent life of plants, and to study the hidden forces of Nature in her sacred sanctuaries; or, yielding to that inherent impulse which for thousands of years has glowed in the breast of man, directs his mind, by a mysterious presentiment of his destiny, towards the celestial orbs, which, in undisturbed harmony, pursue their ancient and eternal course.—HUMBOLDT *Views of Nature*, p. 21. (Bell, 1896.)

417. CAMEL, CHARACTERISTICS OF —*Stolid Endurance Joined with Limited Intelligence.*—The sole good quality that the camel possesses is his seriousness. His intelligence is very limited, he neither shows love nor hate, he is indifferent to everything that is not food or his young. He is irritated whenever he is obliged to work; if he perceives that his wrath is of no avail he submits to his task with the indifference he brings to everything else. He is vicious and dangerous when he is in a rage; his cowardice has no bounds; the roar of a lion will put an entire caravan to flight. Under such circumstances every camel throws down its charge and flees. The howl of a hyena terrifies it; a monkey, a dog, or even a lizard will put it in a fright. I know of no animal with which it is on friendly terms. The donkey's relation to it is kind enough, but of friendship there is no trace. The horse seems to regard him as the most unsightly animal. For his part, the camel appears to regard all other animals with the same bad humor which he feels toward man.—BREHM *La Vie des Animaux illustré, Mammiferes*, p. 443. (Translated for *Scientific Side-Lights.)*

418. CANDOR OF SCIENTIST—*Change of Opinion with Advancing Knowledge.*—But it is the misfortune of progress that one is forced not only to unlearn a great deal, but, if one has been in the habit of communicating his ideas to others, to destroy much of his own work. I now find myself in this predicament; and after teaching my students for years that the Carboniferous epoch belongs to the Paleozoic or Primary age, I am convinced—and this conviction grows upon me constantly as I free myself from old prepossessions and bias on the subject—that with the Carboniferous epoch we have the opening of the Secondary age in the history of the world.—AGASSIZ *Geological Sketches*, ser. i, ch. 5, p. 140. (H. M. & Co., 1896.)

419. CANNIBALISM NOT PRACTISED BY SHELL-MOUND BUILDERS — The observations of Arctic travelers prove that even if human bones had been found in the shell-mounds, this would not of itself be any evidence of cannibalism; but the absence of such remains satisfactorily shows that the primitive population of the North were free from this practise. On the other hand, the tumuli have supplied us with numerous skeletons which probably belong to the Stone Age. The skulls are very round, and in many respects resemble those of the Lapps, but have a more projecting ridge over the eye.—AVEBURY *Prehistoric Times*, ch. 7, p. 229. (A., 1900.)

420. CAPACITY OF VARIATION A CAPACITY OF IMPROVEMENT — No case is on record of a variable organism ceasing to vary under cultivation. Our oldest cultivated plants, such as wheat, still yield new varieties: our oldest domesticated animals are still capable of rapid improvement or modification.—DARWIN *Origin of Species*, ch. 1, p. 6. (Burt.)

421. CAPITAL, VITAL — *The Young Plant Draws on Accumulated Store.*—The food of plants being in great measure the same for all, and bathing all so that it can be absorbed without effort, their vital processes result almost entirely in profit. Once fairly rooted in a fit place, a plant may thus from the outset add a very large proportion of its entire returns to capital; and may soon be able to carry on its processes on a large scale, tho it does not at first do so. When, however, plants are expenders, namely, during their germination and first stages of growth, their degrees of growth are determined by their amounts of vital capital. It is because the young tree commences life with a ready-formed embryo and store of food sufficient to last for some time, that it is enabled to strike root and lift its head above the surrounding herbage.—SPENCER *Biology*, pt. ii, ch. 1, p. 159. (A., 1900.)

422. CARELESSNESS, CAUSE OF DEATH—*Fatal Result of Neglect—Uncleanliness Destroys Infant Life.*—Careless feeding, in conjunction with a warm, dry summer, invariably results in a high death-rate from this cause. These two causes interact upon each other. A warm temperature is a favorable temperature for the growth of the poisonous micro-organism; a dry season affords ample opportunity for its conveyance through the air. Unclean feeding-bottles are obviously an admirable nidus for these injurious bacteria, for in such a resting-place the three main conditions necessary for bacterial life are well fulfilled, viz.: heat, moisture, and pabulum. The heat is supplied by the warm temperature, the moisture and food by the dregs of milk left in the bottle, and the dry air assists in transit.—NEWMAN *Bacteria*, ch. 6, p. 204. (G. P. P., 1899.)

423. CARE OF OFFSPRING AMONG BIRDS—*Intelligence Combined with Devotion.*—The care of the young and their mental and physical development afford us unequal opportunities for the study of bird-character. We may now become acquainted not only with the species, but with individual birds, and at a time when the greatest demands are made upon their intelligence. We may see the seed-eaters gathering insects and perhaps beating them into a pulp before giving them to their nestlings; or we may learn how the doves, high-holes, and humming-birds pump softened food from their crops down the throats of their offspring. The activity of the parents at this season is amazing. Think of the day's work before a pair of chickadees with a family of six or eight fledglings clamoring for food from daylight to dark!—CHAPMAN *Bird-Life*, ch. 6, p. 70. (A., 1900.)

424. CARE OF OFFSPRING INCREASES AS NUMBER DIMINISHES—*Maternal Instinct among Birds—Division of Labor among Them—Man's Single and Costly Infancy.*—With birds, the necessity of maintaining a high temperature for the eggs leads to the building of nests, to a division of labor in the securing of food, to the development of a temporary maternal instinct, and to conjugal alliances which in some birds last for a lifetime. As the eggs become effectively guarded the number diminishes, till instead of millions there are half a dozen. When it comes to her more valuable products Nature is not such a reckless squanderer after all. So with mammals, for the most part the young are in litters of half a dozen or so; but in man, with his prolonged and costly infancy, parental care reaches its highest development and concentration in rearing children one by one.—FISKE *Through Nature to God*, pt. ii, ch. 11, p. 118. (H. L. & Co., 1900.)

425. CASTS OF VANISHED REMAINS—*Mold of Skeleton Preserved in Rock.*—I have had occasion to work out the nature of fossil remains of which there was nothing left except casts of the bones, the solid material of the skeleton having been dissolved out by percolating water. It was a chance, in this case, that the sandstone happened to be of such a constitution as to set, and to allow the bones to be afterward dissolved out, leaving cavities of the exact shape of the bones. Had that constitution been other than what it was, the bones would have been dissolved, the layers of sandstone would have fallen together into one mass, and not the slightest indication that the animal had existed would have been discoverable.—HUXLEY *American Addresses*, lect. 2, p. 45. (A., 1898.)

426. CAUSALITY, THE IDEA OF, INHERENT IN MAN—*Science Springs from the Search for Causes.*—All our notions of Nature, however exalted or however grotesque, have some foundation in experience. The notion of personal volition in Nature had this basis. In the fury and the serenity of natural phenomena the savage saw the transcript of his own varying moods, and he accordingly ascribed these phenomena to beings of like passions with himself, but vastly transcending him in power. Thus the notion of causality—the assumption that natural things did not come of themselves, but had unseen antecedents—lay at the root of even the savage's interpretation of Nature. Out of this bias of the human mind to seek for the antecedents of phenomena all science has sprung.—TYNDALL *Lectures on Light*, lect. 1, p. 4. (A., 1898.)

427. CAUSATION, PERSONAL, AN ULTIMATE FACT OF CONSCIOUSNESS—*Force, as Known to Man, Connected with Conscious Mind.*—There is a philosophy which has fully as true and as broad a basis in man's psychical experience as can be claimed for the fabric of physical science; and in the admirable words of the great master I have already quoted (Sir John Herschel, in his "Familiar Lectures on Scientific Subjects," p. 460), I shall sum up an argument which this paper is intended rather to illustrate and enforce by an appeal to the familiar facts of consciousness than to present in strict logical form:

"In the mental sense of effort, clear to the apprehension of every one who has ever performed a voluntary act, which is present at the instant when the determination to do a thing is carried out into the act of doing it, we have a consciousness of immediate and personal causation which cannot be disputed or ignored. And when we see the same kind of act performed by another, we never hesitate in assuming for him that consciousness which we recognize in ourselves; and in this case we can verify our conclusion by oral communication." "In the only case in which we are admitted into any personal knowledge of the origin of force, we find it connected (possibly by intermediate links untraceable by our faculties, yet

indisputably connected) with volition, and by inevitable consequence, with motive, with intellect, and with all those attributes of mind in which personality consists."—CARPENTER *Nature and Man*, lect. 12, p. 363. (A., 1889.)

428. CAUSE AND EFFECT IN MENTAL PHENOMENA — *Law in Realm of Mind.*—When we pass from the phenomena of matter to the phenomena of mind, we do not pass from under the reign of law. Here, too, facts do range themselves in an observed order; here, too, there is a chain of cause and effect running throughout all events; here, too, we see around us, and feel within us, the work of forces which have always a certain definite tendency to produce certain definite results; here, too, it is by combination and adjustment among these forces that they are mutually held in check; here, too, accordingly, special ends can only be accomplished by the use of special means.—ARGYLL *Reign of Law*, ch. 6, p. 163. (Burt.)

429. CAUSE AND EFFECT, TESTS OF—*Change of Result Corresponding to Change of Agency.*—The dependence of one thing upon another is ordinarily shown by two classes of facts—the first, the presence of the cause followed by the presence of the effect; the second, the absence of the cause followed by the absence of the effect; as when we prove that lighting a fire is the cause of smoke, or oxygen the cause of putrefaction and decay. Of the two methods, the second—the absence of the cause followed by the absence of the effect—is the most decisive; the preservation of meat by excluding air is the best proof that air, or some ingredient of it, is the cause of putrefaction. More especially convincing is the abrupt removal of a supposed cause, leading at once to the suspension of an effect. There are cases, however, where we cannot make the experiment of removing an agent. We cannot get away from the earth where we live. We cannot remove the moon from its sphere, so as to see what actions on the earth depend upon it; we cannot by an abrupt suspension of lunar gravitation prove that the tides are very largely dependent on lunar influence. For such cases, recourse is had to a third expedient, which happily solves the difficulty, and furnishes the proof required. If the agency in question, altho irremovable, passes through gradations whose amount can be measured, we are able to observe whether the effect has corresponding changes of degree; and if a strict concomitance is observable between the intensity of the cause and the intensity of the effect, we have a presumption that may rise to positive proof of the connection. It is thus shown that the tides depend on the moon and the sun conjointly; that the gaseous and liquid states of matter are due to heat.—BAIN *Mind and Body*, ch. 3, p. 5. (Hum., 1880.)

430. CAUSE BEHIND CAUSE—*Subterranean Forces Built the Mountains—Rain, Snow, Frost, and Rivers Carved Them into Shape.*—We are led by recent geological investigations to reject the notions which were formerly accepted, by which mountain ranges were supposed to be suddenly and violently upheaved by volcanic forces. . . . The actual forms of the mountain ranges are due directly to the action of denuding forces, which have sculptured out from the rude rocky masses all the varied outlines of peaks and crags, of ravines and valleys. But it is none the less true that the determining causes which have directed and controlled all this earth-sculpture are found in the relative positions of hard and soft masses of rock; but these rock-masses have acquired their hardness and consistency, and have assumed their present positions, in obedience to the action of subterranean forces. Hence we see that tho the formation of mountain ranges is proximately due to the denuding forces, which have sculptured the earth's surface, the primary cause for the existence of such mountain chains must be sought for in the fact that subterranean forces have been at work, folding, crumpling, and hardening the soft sediments, and placing them in such positions that, by the action of denudation, the more indurated portions are left standing as mountain masses above the general surface.—JUDD *Volcanoes*, ch. 10, p. 290. (A., 1899.)

431. CAUSE BEHIND THE PRIMORDIAL GERM — In the case of Mr. Darwin, observation, imagination, and reason combined have run back with wonderful sagacity and success over a certain length of the line of biological succession. Guided by analogy, in his "Origin of Species" he placed at the root of life a primordial germ, from which he conceived the amazing variety of the organisms now upon the earth's surface might be deduced. If this hypothesis were even true, it would not be final. The human mind would infallibly look behind the germ, and, however hopeless the attempt, would inquire into the history of its genesis.—TYNDALL *Fragments of Science*, vol. ii, ch. 8, p. 127. (A., 1897.)

432. CAUSE DEMANDED BY HUMAN MIND FOR EVERY EFFECT — Every occurrence in Nature is preceded by other occurrences which are its causes, and succeeded by others which are its effects. The human mind is not satisfied with observing and studying any natural occurrence alone, but takes pleasure in connecting every natural fact with what has gone before it, and with what is to come after it.—TYNDALL *Forms of Water*, p. 1. (A., 1899.)

433. CAUSE, FINAL, NEVER FULLY KNOWN—*We See Immediate, Not Ultimate, Purpose.*—When man makes an implement, he knows the purpose for which he makes it

—he knows the function assigned to it in his own intention. But as in making it there are a thousand chips and fragments of material which he casts aside, so in its final use it often produces consequences and results which he did not contemplate or foresee. But in Nature all this is different. Nature has no chips or fragments which she does not put to use; and as on the way to her apparent ends there are no incidents which she did not foresee, so beyond those ends there are no ulterior results which do not open out into new firmaments of design. Of nothing, therefore, can we say with even the probability of truth that we see its final cause; that is to say, its ultimate purpose. All that we can ever see are the facts of adjustment and of function, and these constitute not final but immediate purpose. But a purpose is not less a purpose because other purposes may lie beyond it. And not only can we detect purpose in natural phenomena, but . . . it is very often the only thing about them which is intelligible to us. The how is very often incomprehensible where the why is apparent at a glance. And be this observed, that when purpose is perceived it is a "making plain" to a higher faculty of the mind than the mere sense of order. It is a making plain to reason. It is the reduction of phenomena to that order of thought which is the basis of all other order in the works of man, and which, he instinctively concludes, is the basis also of all order in the works of Nature.—ARGYLL *Reign of Law*, ch. 2, p. 49. (Burt.)

434. CAUSE OF MIGRATION OF BIRDS —*Nesting-season the Controlling Factor—Bird Goes against Appearances.*—Why do birds migrate? It is true that in temperate and boreal regions the return of cold weather robs them of their food, and they retreat southward. But many, in fact most, birds begin their southern journey long before the first fall frost. We have seen that some species start as early as July and August. Furthermore, there are many birds that come to our Gulf and South Atlantic States to nest, and when the breeding season is over they return to the tropics. Surely, a lower temperature cannot be said to compel them to migrate. Even more remarkable than the southward journey in the fall is the northward journey in the spring. Our birds leave their winter homes in the tropics in the height of the tropical spring, when insect and vegetable food is daily increasing. They leave this land of plenty for one from which the snows of winter have barely disappeared, often coming so early that unseasonable weather forces them to retreat.

I believe that the origin of this great pilgrimage of countless millions of birds is to be found in the existence of an annual nesting-season. . . . There is good reason for the belief that the necessity of securing a home in which their young could be reared was, as it still is, the cause of migration.—CHAPMAN *Bird-Life*, ch. 4, p. 58. (A., 1900.)

435. CAUSE, PHYSICAL, OF THE ALPS—*All Earthly Energy Derived from the Sun.*—And as I looked over this wondrous scene towards Mont Blanc, the Grand Combin, the Dent Blanche, the Weisshorn, the Dom, and the thousand lesser peaks which seemed to join in celebration of the risen day, I asked myself, as on previous occasions: How was this colossal work performed? Who chiseled these mighty and picturesque masses out of a mere protuberance of the earth? And the answer was at hand. Ever young, ever mighty—with the vigor of a thousand worlds still within him —the real sculptor was even then climbing up the eastern sky. It was he who raised aloft the waters which cut out these ravines; it was he who planted the glaciers on the mountain slopes, thus giving gravity a plow to open out the valleys; and it is he who, acting through the ages, will finally lay low these mighty monuments, rolling them gradually seaward—

Sowing the seeds of continents to be;

so that the people of an older earth may see mold spread and corn wave over the hidden rocks which at this moment bear the weight of the Jungfrau.—TYNDALL *Hours of Exercise in the Alps*, ch. 17, p. 190. (A., 1898.)

436. CAUSE, SAME, PRODUCES UNLIKE EFFECTS—*Dew and Frost Results of Radiation.*—It is thus that dew is produced. By the effect of nocturnal radiation bodies exposed in the open air are cooled down, and this cooling condenses on them the vapor of water diffused in the atmosphere. Dew does not descend from the sky, nor does it rise from the earth. A light covering, a sheet of paper, a cloud, is sufficient to check the radiation and prevent dew, as it would prevent frost.—FLAMMARION *Popular Astronomy*, bk. ii, ch. 8, p. 175. (A.)

437. CAUSE SEEN IN LEAST EFFECT —*Motions of Stars Overwhelm Thought.*—In the falling of a rock from a mountain-head, in the shoot of an avalanche, in the plunge of a cataract, we often see more impressive illustrations of the power of gravity than in the motions of the stars. When the intellect has to intervene, and calculation is necessary to the building up of the conception, the expansion of the feelings ceases to be proportional to the magnitude of the phenomena.—TYNDALL *Hours of Exercise in the Alps*, ch. 20, p. 251. (A., 1898.)

438. CAUSE, THE HIGHEST WORK OF SCIENCE TO FIND—*Three Departments of Scientific Study—Observation; Experiment, Theory.*—In the house of science are many mansions, occupied by tenants of diverse kinds. Some of them execute with painstaking fidelity the useful work of ob-

servation, recording from day to day the aspects of Nature, or the indications of instruments devised to reveal her ways. Others there are who add to this capacity for observation a power over the language of experiment, by means of which they put questions to Nature, and receive from her intelligible replies. There is, again, a third class of minds, that cannot rest content with observation and experiment, whose love of causal unity tempts them perpetually to break through the limitations of the senses, and to seek beyond them the roots and reasons of the phenomena which the observer and experimenter record. To such spirits—adventurous and firm—we are indebted for our deeper knowledge of the methods by which the physical universe is ordered and ruled.—TYNDALL *Fragments of Science*, vol. i, ch. 5, p. 131. (A., 1897.)

439. CAUSES, KNOWLEDGE OF, SAVES LIFE—*Bacteria Recognized, Antiseptic Treatment Follows—Surgery Conquers Wounds and Disease.*—Even more important was the introduction of the antiseptic treatment in 1865, which, by preventing the suppuration of incised or wounded surfaces, has reduced the death-rate for serious amputations from forty-five per cent. to twelve per cent., and has besides rendered possible numbers of operations which would have been certainly fatal under the old system. . . . The antiseptic treatment was the logical outcome of the proof that suppuration of wounds and all processes of fermentation and putrefaction were not due to normal changes either in living or dead tissues, but were produced by the growth and the rapid multiplication of minute organisms, especially of those low fungoid groups termed bacteria. If, therefore, we can adopt measures to keep away or destroy these organisms and their germs, or in any way prevent their increase, injured living tissues will rapidly heal. . . . In the case of wounds and surgical operations this is effected by means of a weak solution of corrosive sublimate, in which all instruments and everything that comes in contact with the wound are washed, and by filling the air around the part operated on with a copious spray of carbolic acid.—WALLACE *The Wonderful Century*, ch. 14, p. 148. (D. M. & Co., 1899.)

440. CAUTION NEEDED IN INTERPRETING DISCOVERIES—Stone weapons, however, of many kinds were still in use during the Age of Bronze, and lingered on even into that of iron, so that the mere presence of a few stone implements is not in itself sufficient evidence that any given "find" belongs to the Stone Age.—AVEBURY *Prehistoric Times*, ch. 1, p. 3. (A., 1900.)

441. CAVE-MEN OF DENMARK LIKE MODERN FUEGIANS—*Hunting and Fishing the Great Reliance of Primitive Man.*—The Fuegians wander along their bleak inhospitable shores, feeding mostly on shell-fish, so that in the course of ages their shells, with fish-bones and other rubbish, have formed long banks above high-water mark. Such shell-heaps, or "kitchen-middens," are found here and there all round the coasts of the world, marking the old resorts of such tribes; for instance, on the coast of Denmark, where archeologists search them for relics of rude Europeans, who, in the Stone Age, led a life somewhat like that of Terra del Fuego. Hunting and fishing go on through all levels of society, beginning with the savages who have no other means of subsistence, till at last among civilized nations game and fish hardly do more than supplement the more regular supplies of grain and meat from the farm. Looking at the devices of the hunter and fisher, it will be seen how thoroughly most of them belong to the ruder stages of culture.—TYLOR *Anthropology*, ch. 9, p. 207. (A., 1899.)

442. CAVERNS CARVED BY OCEAN-WAVES—*Fingal's Cave—Remains of Ancient Beaches.*—We are, perhaps, generally disposed to associate the formation of caves with the action of the waves upon a rocky shore, and certainly some of the most remarkable caves are due to this cause. The process of attrition can indeed often be observed in actual progress, and those who have seen the gigantic waves break upon a rock-bound coast, and have observed the huge masses of stone which have been torn away like so many fragments of timber and strewn upon the beach, can form some tolerably accurate idea of the power of the sea to eat its way into the face of any cliff when once it has found a weak place in the rock. . . . [Such is the] familiar cavern known as Fingal's Cave, which is due to the action of the waves. These sea-worn caves are easily distinguished from those formed by other agencies. They are seldom of great extent, and they generally lie in a tolerably horizontal plane. Sometimes they lie far above the present water-line, but the nearly level floor, the indication in their vicinity of an ancient beach, and the fact that in many cases at least similar caves of greater or less extent are to be observed opening on the same general horizon, prove conclusively that they must be due to the prolonged beating of the ocean-waves upon a rocky shore.—DALLAS *Nature-Studies*, p. 37. (Hum., 1888.)

443. CAVES AS READY-MADE HOUSES—*The Cave-men of Europe.*—Rock-shelters under the cliffs were in Europe the resort of the ancient savages, as is proved by the bones and flint flakes and other remains that are found lying there in the ground. Caves are ready-made houses for beast or man. It has been already mentioned how in such countries as England and France caverns were the abodes of the old tribes of the reindeer and mammoth period, and the bushmen of South Africa

are a modern example of rude tribes thus given to dwelling in caves in the rocks. But caverns are so convenient that they are now and then still used in the civilized world, and most of us have seen some cave in a cliff forming the back of a fisherman's cottage, or at least a storehouse.—TYLOR *Anthropology*, ch. 10, p. 229. (A., 1899.)

444. CEDARS OF THE HIMALAYAS—*Timber for the Gods.*—On the Himalayas the acicular-leaved form of trees is distinguished by the mighty thickness and height of the stem as well as by the length of the leaf. The chief ornament of the mountain range is the cedar Deodwara [deodar] *(Pinus Deodara,* Roxb.) [*Cedrus Deodara*], which word is, in Sanskrit, dewa-dâru—*i. e.*, timber for the gods—its stem being nearly from 13 to 14 feet in diameter. It ascends in Nepaul to more than 11,700 feet above the level of the sea. More than 2,000 years ago the Deodwara cedar, near the River Behut—that is, the Hydaspes—furnished the timber for the fleet of Nearchus.—HUMBOLDT *Views of Nature,* p. 317. (Bell, 1896.)

445. CELL, THE FUNDAMENTAL UNIT OF ALL LIVING THINGS—The first of the great fundamental conceptions referred to is the cell theory, which was definitely established for plants in 1838, and immediately afterward for animal structures. The theory is that all the parts and tissues of plants and animals are built up of cells, modified in form and function in an infinite variety of ways, but to be traced in the early stages of growth, alike of bone and muscle, nerve and blood-vessel, skin and hair, root, wood, and flower. And, further, that all organisms originate in simple cells, which are almost identical in form and structure, and which thus constitute the fundamental unit of all living things.—WALLACE *The Wonderful Century,* ch. 14, p. 143. (D. M. & Co., 1899.)

446. ——— ——— *The Constitution of the Ameba.*—The creature which naturalists call the Ameba, one of the lowest in the animal series, consists of nothing but an apparently simple and formless jelly. But simple, and formless as it appears to be, this jelly exhibits all the wonder and mystery of that power which we know as life. It is in virtue of that power that the dead or inorganic elements of which it is composed are held together in a special and delicate combination, which no other power can preserve in union, and which begins to dissolve the moment that power departs. And as in virtue of this power the constituent elements are held in a peculiar relation to each other, so in virtue of the same power does the combination possess peculiar relations with external things. It has the faculty of appropriating foreign substances into its own, making them subservient to the renewal of its own material, to the maintenance of its own energy, and to the preservation of its own separate individuality. It has the faculty, moreover, of giving off parts of itself, endowed with the same properties, to lead a separate existence. This same substance, which when analyzed has always the same chemical composition, and when alive has always the same fundamental properties, is at the root of every organism, whether animal or vegetable.—ARGYLL *Unity of Nature,* ch. 2, p. 29. (Burt.)

447. CELLS THE POPULATION OF THE VITAL KINGDOM—*Perfect Division of Labor—Definition and Size of Cell.*—What, then, is a cell? Imagine a speck of this living matter, averaging, say, the one-four-hundredth of an inch in diameter, of rounded shape, bounded by a kind of envelope, and having a particle (the nucleus) somewhere or other embedded in its interior, and you will have a fair conception of what a cell of ordinary size and form is likely to be. Some cells we know of—nerve-cells, indeed—average only the one-five-thousandth of an inch, or less, in diameter; and between big cells and little cells there are, of course, all gradations in size. These cells, then, are the workers of the body. They are the population of the vital kingdom. . . . There is perfect division of labor in the living state. One group of cells does not interfere with the work of another group. Each piece of labor, from the building of bone to the making of gastric juice, is carried out independently and thoroughly by workers set apart for the given purpose. The economy of a bee's hive is not more rigidly ordered than is the work of our own body in respect of its laborers and their specific duties.—ANDREW WILSON *Glimpses of Nature,* ch. 25, p. 81. (Hum., 1892.)

448. CERTAINTY AND CONJECTURE—*True Science Will Not Confuse.*—The burden, however, of this celebrated lecture [of Virchow] is a warning that a marked distinction ought to be made between that which is experimentally proved and that which is still in the region of speculation. . . . He insists that it [speculation] ought not to be put on the same evidential level as the former. "It ought," as he poetically expresses it, "to be written in small letters under the text." The audience ought to be warned that the speculative matter is only possible not actual truth—that it belongs to the region of "belief," and not to that of demonstration. As long as a problem continues in this speculative stage it would be mischievous, he considers, to teach it in our schools. "We ought not," he urges, "to represent our conjecture as a certainty, nor our hypothesis as a doctrine: this is inadmissible."—TYNDALL *Fragments of Science,* vol. ii, ch. 15, p. 397. (A., 1900.)

449. CERTAINTY OF INSTINCT—*Young Turtles and Crocodiles Readily Find Their Way to Unseen Water.*—Dr.

Davy, in his "Account of Ceylon," gives an interesting observation of his own on a young crocodile, which he cut out of the egg, and which, as soon as it escaped, started off in a direct line for a neighboring stream. Dr. Davy placed his stick before it to try to make the little animal deviate from its course; but it stoutly resisted the opposition, and raised itself into a posture of offense, just as an older animal would have done. Humboldt made exactly the same observation with regard to young turtles, and he remarks that, as the young normally quit the egg at night, they cannot see the water which they seek, and must therefore be guided to it by discerning the direction in which the air is most humid. He adds that experiments were made which consisted in putting the newly hatched animals into bags, carrying them to some distance from the shore, and liberating them with their tails turned towards the water. It was invariably found that the young animals immediately faced round and took without hesitation the shortest way to the water.—ROMANES *Animal Intelligence*, ch. 8, p. 257. (A., 1899.)

450. CERTAINTY, SCIENTIFIC, THE GROUND OF—*A Stable Consensus of Belief.*—It would thus appear that philosophy tends, after all, to unsettle what appear to be permanent convictions of the common mind and the presuppositions of science much less than is sometimes imagined. Our intuitions of external realities, our indestructible belief in the uniformity of Nature, in the nexus of cause and effect, and so on, are, by the admission of all philosophers, at least partially and relatively true; that is to say, true in relation to certain features of our common experience. At the worst, they can only be called illusory as slightly misrepresenting the exact results of this experience. And even so, the misrepresentation must, by the very nature of the case, be practically insignificant. And so in full view of the subtleties of philosophic speculation, the man of science may still feel justified in regarding his standard of truth, a stable consensus of belief, as above suspicion.—SULLY *Illusions*, ch. 12, p. 361. (A., 1897.)

451. CHALK CLIFFS OF ENGLAND WERE ONCE PART OF THE OCEAN FLOOR—However, the important points for us are, that the living *Globigerinæ* [see MICRO-ORGANISMS] are exclusively marine animals, the skeletons of which abound at the bottom of deep seas; and that there is not a shadow of reason for believing that the habits of the *Globigerinæ* of the chalk differed from those of the existing species. But if this be true, there is no escaping the conclusion that the chalk itself is the dried mud of an ancient deep sea.—HUXLEY *Lay Sermons*, ch. 9, p. 186. (G. P. P., 1899.)

452. CHANCE, A WORLD OF—*Cause and Effect Abolished—Reason Impossible.*—There used to be a children's book which bore the fascinating title of "The Chance World." It described a world in which everything happened by chance. The sun might rise or it might not; or it might appear at any hour, or the moon might come up instead. When children were born they might have one head or a dozen heads, and those heads might not be on their shoulders—there might be no shoulders—but arranged about the limbs. If one jumped up in the air it was impossible to predict whether he would ever come down again. That he came down yesterday was no guarantee that he would do it next time. For every day antecedent and consequent varied, and gravitation and everything else changed from hour to hour. To-day a child's body might be so light that it was impossible for it to descend from its chair to the floor; but to-morrow, in attempting the experiment again, the impetus might drive it through a three-story house and dash it to pieces somewhere near the center of the earth. In this chance world cause and effect were abolished. Law was annihilated. And the result to the inhabitants of such a world could only be that reason would be impossible. It would be a lunatic world with a population of lunatics.—DRUMMOND *Natural Law in the Spiritual World*, p. 33. (H. Al.)

453. CHANCE DOES NOT GIVE COHERENCE AND CONSISTENCY—*Earth's Progress Marked by Consistent Purpose.*—The tree is known by its fruits, and the fruits of chance are incoherence, incompleteness, unsteadiness, the stammering utterance of blind, unreasoning force. A coherence that binds all the geological ages in one chain, a stability of purpose that completes in the beings born to-day an intention expressed in the first creatures that swam in the Silurian ocean or crept upon its shores, a stedfastness of thought, practically recognized by man, if not acknowledged by him, whenever he traces the intelligent connection between the facts of Nature and combines them into what he is pleased to call his system of geology, or zoology, or botany—these things are not the fruits of chance or of an unreasoning force, but the legitimate results of intellectual power.—AGASSIZ *Geological Sketches*, ser. i, ch. 1, p. 21. (H. M. & Co., 1896.)

454. CHANCE FINALLY RULED OUT OF NATURE—*No "Fortuitous Concourse of Atoms"—Law Rules the Universe.*—The element of chance, which some atheists formerly admitted into their scheme of things, is expelled. Nobody would now waste his time in theorizing about a fortuitous concourse of atoms. We have so far spelled out the history of creation as to see that all has been done in strict accordance with law. The method has been the method of evolution, and the more we study it the more do we discern in it intelligible coherence. One

part of the story never gives the lie to another part.—FISKE *Through Nature to God*, pt. iii, ch. 2, p. 147. (H. M. & Co., 1900.)

455. CHANGE ALWAYS THE RESULT OF PREPARATION—*The Law of Continuity —Necessity of Belief in Causation.*—There is a common superstition that this so-called law [the law of continuity] shuts out the idea of creation and negatives the possibility, for example, of the sudden appearance of new forms of life. What it does negative, however, is not any appearance which is sudden, but only any appearance which has been unprepared. But these are two very different conceptions, altho they are conceptions very easily confounded. Innumerable things may come to be in a moment—in the twinkling of an eye. But nothing can come to be without a long, even if it be a secret, history. The "law of continuity" is, therefore, a phrase of ambiguous meaning; but at the bottom of it there lies the true and invincible conviction that for every change, however sudden—for every "leap," however wide—there has always been a long chain of predetermining causes, and that even the most tremendous bursts of energy and the most sudden exhibitions of force have all been slowly and silently prepared. In this sense the law of continuity is nothing but the idea of causation. It is founded on the necessary duration which we cannot but attribute to the existence of force, and this appears to be the only truth which the law of continuity represents.—ARGYLL *Unity of Nature*, ch. 4, p. 84. (Burt.)

456. CHANGE AMONG THE STARS—*Sirius Attended by a Darkened Sun.*—The knowledge of the law of gravitation has here also led to the discovery of new bodies, as in the case of Neptune. Peters of Altona found, confirming therein a conjecture of Bessel, that Sirius, the most brilliant of the fixed stars, moves in an elliptical path about an invisible center. This must have been due to an unseen companion, and when the excellent and powerful telescope of the University of Cambridge, in the United States, had been set up, this was discovered. It is not quite dark, but it light is so feeble that it can only be seen by the most perfect instruments. The mass of Sirius is found to be 13.76, and that of its satellite 6.71, times the mass of the sun; their mutual distance is equal to thirty-seven times the radius of the earth's orbit, and is therefore somewhat larger than the distance of Neptune from the sun. Another fixed star, Procyon, is in the same case as Sirius, but its satellite has not yet been discovered. You thus see that in gravitation we have discovered a property common to all matter, which is not confined to bodies in our system, but extends as far in the celestial space as our means of observation have hitherto been able to penetrate.—HELMHOLTZ *Popular Lectures*, lect. 4, p. 150. (L. G. & Co., 1898.)

457. CHANGE, CEASELESS, OF THE EARTH'S POSITION — *Its Path through Space an Infinite Spiral—We Never Twice Visit the Same Place.*—Owing to the existence of this motion [of the whole solar system toward a distant center], our globe has never passed twice through the same place, and it can never return to the spot where it is at present. We fall into the infinite, describing a series of spirals which are continually changing. Our abode is simply a moving globe carried through space, a veritable sport of cosmical forces, speeding through the eternal void towards an end of which we are ignorant, subject in its unsteady course to the most varied oscillations, balancing itself in the infinite with the lightness of an atom of dust in the sunlight, flying with a dizzy velocity above the unfathomable abyss, and carrying us for thousands of years past, and perhaps for thousands of years to come, to a mysterious destiny, which the most far-seeing mind cannot discern, beyond an horizon always fading into the future.—FLAMMARION *Popular Astronomy*, bk. i, ch. 1, p. 11. (A.)

458. CHANGE, GRADUAL, OF EARTH'S SURFACE—*Inroads of the Sea on British Coast.*—The waves constantly undermine the low chalk cliffs, covered with sand and clay, between Weybourne and Sherringham, a certain portion of them being annually removed. At the latter town I ascertained, in 1829, some facts which throw light on the rate at which the sea gains upon the land. It was computed, when the present inn was built, in 1805, that it would require seventy years for the sea to reach the spot, the mean loss of land being calculated, from previous observations, to be somewhat less than one yard annually. The distance between the house and the sea was fifty yards; but no allowance was made for the slope of the ground being from the sea, in consequence of which the waste was naturally accelerated every year, as the cliff grew lower, there being at each succeeding period less matter to remove when portions of equal area fell down. Between the years 1824 and 1829 no less than seventeen yards were swept away, and only a small garden was then left between the building and the sea. There was, in 1829, a depth of twenty feet (sufficient to float a frigate) at one point in the harbor of that port, where, only forty-eight years before, there stood a cliff fifty feet high, with houses upon it! If once in half a century an equal amount of change were produced suddenly by the momentary shock of an earthquake, history would be filled with records of such wonderful revolutions of the earth's surface; but, if the conversion of high land into deep sea be gradual, it excites only local attention.—LYELL *Principles of Geology*, ch. 19, p. 305. (A., 1854.)

459. CHANGE OF CHARACTER PRODUCED THROUGH CONTACT—*Alloys Made*

by Pressure.—In order to produce chemical changes in bodies, it is usually necessary that one at least be a liquid or be in a state of solution, and the combinations that occur lead to the production of bodies having quite different properties from either of their components. Similar results occur when metals are mixed together, forming alloys. Thus a mixture in certain proportions of lead, tin, bismuth, and cadmium produces an alloy which melts in boiling water, while the component metals only melt at double that temperature or more. Again, the strength of gold is doubled by the addition of one-five-hundredth part of the rare metal zirconium, indicating that the alloy must have a new arrangement of the molecules. But the interesting point is that alloys can be produced without melting the metals, for mere pressure often produces an alloy at the surfaces of contact; while in other cases, if fine filings of the component metals are thoroughly mixed together and then subjected to continued pressure, true alloys are produced.—WALLACE *The Wonderful Century,* ch. 7, p. 56. (D. M. & Co., 1899.)

460. CHANGE OF CLIMATE OF NORTH AMERICA—*Once the Home of Mastodon, Mammoth, and Camel.*—Of the remains of vertebrates, the bones of the mastodon or mammoth, and of the ox, camel, and horse, have been found in the sediments of Lake Lahontan, together with a single undetermined fish. The bones of a musk-ox were obtained near Salt Lake City under such conditions that it is believed they were buried in the upper strata of the Bonneville sediments. . . . The mastodon and mammoth roamed over nearly the whole of North America during Pleistocene times, but have since become extinct. The camel is no longer found on this continent, and the horse was extinct before the coming of the white man. The musk-ox is now found only far to the north. The extinction of some of these large animals, and the scattering of others to distant regions, suggests the lapse of a long period of time since they lived together where their remains are now found, and also points to great changes in climatic and other elements of their environment.—RUSSELL *Lakes of North America,* ch. 6, p. 114. (G. & Co., 1895.)

461. CHANGE OF COLOR AS THE EFFECT OF SIGHT—*The Chameleon—Flatfish—Variable Protective Coloring.*—[In some cases] the change [of color] is caused by reflex action set up by the animal seeing the color to be imitated, and the change produced can be altered or repeated as the animal changes its position. . . . The most striking example . . . is that of the chameleon, which changes to white, brown, yellowish, or green, according to the color of the object on which it rests. This change is brought about by means of two layers of pigment cells, deeply seated in the skin, and of bluish and yellowish colors. By suitable muscles these cells can be forced upwards so as to modify the color of the skin, which, when they are not brought into action, is a dirty white. These animals are excessively sluggish and defenseless, and the power of changing their color to that of their immediate surroundings is no doubt of great service to them. Many of the flatfish are also capable of changing their color according to the color of the bottom they rest on.—WALLACE *Darwinism,* ch. 8, p. 133. (Hum., 1889.)

462. CHANGE OF EYES TO SUIT ENVIRONMENT IN DEEP-SEA ORGANISMS—If the animals that now live in the depths of the sea are descended from the shallow-water forms of bygone epochs, they must have passed through many different habitats with diminished light until they reached their present dark abode in the abyss. In every new region they came to, the forms with larger and better eyes would be at an advantage in the fainter light, and would be more likely to survive and transmit their favorable variation in this respect to their offspring, than their less fortunate neighbors. Thus down to the depth of the limit of sunlight we should expect to find, as we do find in fishes, large-eyed species.—HICKSON *Fauna of the Deep Sea,* ch. 4, p. 74. (A., 1894.)

463. CHANGE OF FORMS FROM ANCIENT TO MODERN—*The Chambered Nautilus.*—The chambered nautilus is familiar to all, since, from the exquisite beauty of its shell, it is especially sought for by conchologists; but it is nevertheless not so common in our days as the squids and cuttlefishes, which are the most numerous modern representatives of the class. In the earliest geological days, on the contrary, those with a shell predominated, differing from the later ones, however, in having the shell perfectly straight instead of curved, tho its internal structure was the same as it is now and has ever been. Then, as now, the animal shut himself out from his last year's home, building his annual wall behind him, till his whole shell was divided into successive chambers, all of which were connected by a siphon. Some of the shells of this kind belonging to the Silurian deposits are enormous: giants of the sea they must have been in those days. They have been found fifteen feet long, and as large round as a man's body.—AGASSIZ *Geological Sketches,* ser. i, ch. 2, p. 49. (H. M. & Co., 1896.)

464. CHANGE OF HABITS IN A BIRD—*The Kea (Parrot) of New Zealand.*—The kea *(Nestor notabilis)* is a curious parrot inhabiting the mountain ranges of the Middle Island of New Zealand. It belongs to the family of brush-tongued parrots, and naturally feeds on the honey of flowers and the insects which frequent them, together with such fruits or berries as are found in

the region. Till quite recently this comprised its whole diet, but since the country it inhabits has become occupied by Europeans it has developed a taste for a carnivorous diet, with alarming results. It began by picking the sheepskins hung out to dry or the meat in process of being cured. About 1868 it was first observed to attack living sheep, which had frequently been found with raw and bleeding wounds on their backs. Since then it is stated that the bird actually burrows into the living sheep, eating its way down to the kidneys, which form its special delicacy. As a natural consequence, the bird is being destroyed as rapidly as possible. . . . The case affords a remarkable instance of how the climbing feet and powerful hooked beak developed for one set of purposes can be applied to another altogether different purpose, and it also shows how little real stability there may be in what appear to us the most fixed habits of life.—WALLACE *Darwinism,* ch. 3, p. 52. (Hum., 1889.)

465. CHANGE OF HEART—*Effect of Grief or Fear—New Mental Level Produces New Perspective.*—There is a form of decision [in which], in consequence of some outer experience or some inexplicable inward change, we suddenly pass from the easy and careless to the sober and strenuous mood, or possibly the other way. The whole scale of values of our motives and impulses then undergoes a change like that which a change of the observer's level produces on a view. The most sobering possible agents are objects of grief and fear. When one of these affects us, all "light fantastic" notions lose their motive power, all solemn ones find theirs multiplied manifold. The consequence is an instant abandonment of the more trivial projects with which we had been dallying, and an instant practical acceptance of the more grim and earnest alternative which till then could not extort our mind's consent. All those "changes of heart," "awakenings of conscience," etc., which make new men of so many of us, may be classed under this head. The character abruptly rises to another "level," and deliberation comes to an immediate end.—JAMES *Psychology,* vol. ii, ch. 26, p. 533. (H. H. & Co., 1899.)

466. CHANGE OF POSITIONS OF FIXED STARS—*Not One Star of Greek Astronomers Now Holds Its Place Unchanged—"Fixed Stars" a Misnomer.*—The heaven of the fixed stars, in contradiction to its very name, exhibits not only changes in the intensity of light, but also further variation from the perpetual motion of the individual stars. Allusion has already been made to the fact that, without disturbing the equilibrium of the star systems, no fixed point is to be found in the whole heavens, and that of all the bright stars observed by the earliest of the Greek astronomers, not one has kept its place unchanged. In the case of Arcturus, of *υ* Cassiopeiæ, and of a double star in Cygnus, this change of position has, by the accumulation of their annual proper motion during 2,000 years, amounted, respectively, to 2½, 3½, and 6 moon's diameters. In the course of 3,000 years about twenty fixed stars will have changed their places by 1° and upward. Since the proper motions of the fixed stars rise from $\frac{1}{20}$th of a second to 7.7 seconds (and consequently differ, at the least, in the ratio of 1.154), the relative distances also of the fixed stars from each other, and the configuration of the constellations themselves, cannot in long periods remain the same. The Southern Cross will not always shine in the heavens exactly in its present form, for the four stars of which it consists move with unequal velocity in different paths. How many thousand years will elapse before its total dissolution cannot be calculated. In the relations of space and the duration of time, no absolute idea can be attached to the terms great and small.—HUMBOLDT *Cosmos,* vol. iii, p. 182. (H., 1897.)

467. CHANGE OF SKIES IN SOUTHERN CLIMES—*Reversal of All Ideas of Position—The Sun North at Noon.*—If we travel southward we find that the north pole gradually sinks towards the horizon, while new stars come into view above the south horizon; consequently the circles of perpetual apparition and of perpetual disappearance both grow smaller. When we reach the earth's equator the south pole has risen to the south horizon, the north pole has sunk to the north horizon; the celestial equator passes from east to west directly overhead; and all the heavenly bodies in their diurnal revolutions describe circles of which one-half is above and the other half below the horizon. These circles are all vertical. South of the equator only the south pole is visible, the north one, which we see, being now below the horizon. Beyond the southern tropic the sun is north at noon, and, instead of moving from left to right, its course is from right to left.—NEWCOMB *Popular Astronomy,* ch. 1, p. 13. (H., 1899.)

468. CHANGE OF VIEW OF SCIENTIST—*Spencer Accepts Natural Selection.*—In the days when, not having been better instructed by Mr. Darwin, I believed that all changes of structure in organisms result from changes of function, I held that the cause of such changes of function is migration. . . . This conception was wrong in so far as it ascribed the production of new species entirely to inheritance of functionally wrought alterations (thus failing to recognize natural selection, which was not yet enunciated).—SPENCER *Biology,* pt. iii, ch. 14A, p. 568. (A., 1900.)

469. CHANGE, SILENT WITNESS OF—*Surface, Former, of Earth Removed—Granite from Depths Found at New Surface.*

—Granite [is] a rock believed to be of deep-seated origin. Its Plutonic character is evinced not less by its composition and structure than by its relation to the rock-masses that surround it. Every mass of granite, then, has cooled and consolidated, probably very slowly, and certainly at a less or greater depth in the earth's crust. When this rock is met with over a wide area at the actual surface, therefore—forming, it may be, great mountains or rolling and broken lowlands—we know that in such regions thick masses of formerly overlying rocks have been removed. The granite appears at the surface simply because the covering of rocks underneath which it cooled and solidified has been subsequently carried away.—GEIKIE *Earth Sculpture*, ch. 1, p. 16. (G. P. P., 1898.)

470. CHANGE THE CONDITION OF LIFE—*Repose of the Earth Will Be Its Death.* —As long as our planet yields less heat to space than she receives from the bodies of space, so long will the forms upon her surface undergo mutation, and as soon as equilibrium, in regard to heat, has been established we shall have, as Thomson has pointed out, not peace, but death. Life is the product and accompaniment of change, and the selfsame power that tears the flanks of the hills to pieces is the mainspring of the animal and vegetable worlds. Still there is something chilling in the contemplation of the irresistible and remorseless character of those infinitesimal forces, whose integration through the ages pulls down even the Matterhorn. Hacked and hurt by time, the aspect of the mountain from its higher crags saddened me. Hitherto the impression that it made was that of savage strength, but here we had inexorable decay.—TYNDALL *Hours of Exercise in the Alps*, ch. 24, p. 291. (A., 1898.)

471. CHANGE, UNCEASING, OF THE "SOLID EARTH"—*Continents Rising beneath Our Feet—"Thou Renewest the Face of the Earth" (Ps. civ, 30).*—It is certain that during the enormous periods of time of which the records have been discovered by the geologist there have always been continents and oceans upon the earth's surface, just as at present, and it is almost equally certain that the proportions of the earth's surface occupied by land and water, respectively, have not varied very widely from those which now prevail. But, at the same time, it is an equally well-established fact that the denuding forces ever at work upon the earth's surface would have been competent to the removal of existing continents many times over, in the vast periods covered by geological records. Hence we are driven to conclude that the subterranean movements have in past times entirely compensated for the waste produced by the denuding forces ever at work upon our globe. But this is not all. The subterranean forces not only produce upheaval; in a great many cases the evidences of subsidence are as clear and conclusive as are those of upheaval in others. Hence we are driven to conclude that the forces producing upheaval of portions of the earth's crust are sufficient, not only to balance those producing subsidence, but also to compensate for the destructive action of denuding agents upon the land-masses of the globe.—JUDD *Volcanoes*, ch. 10, p. 286. (A., 1899.)

472. CHANGE, UNSEEN, INVOLVES LIFE OR DEATH—*Fish Drowns in Airless Water.*—If a fish be placed in cooked water it swims for a while with its mouth at the surface, for just there is a film that is reacquiring its charge of oxygen, etc., by absorbing it from the air; but this film is so thin, and so poorly charged, that after a short struggle the fish dies for lack of oxygen in its blood; drowned as truly and completely as an air-breathing animal when immersed in any kind of water.—WILLIAMS *Chemistry of Cookery*, ch. 2, p. 10. (A., 1900.)

473. CHANGE WROUGHT BY NINETEENTH CENTURY—*Practical Application of Science—Slow Progress in Moral and Social Life.*—The close of the nineteenth century offers one of the most remarkable spectacles to the thoughtful observer. All educated people are agreed that it has in many respects immeasurably outstripped its predecessors, and has achieved tasks that were deemed impracticable at its commencement. An entirely new character has been given to the whole of our modern civilization, not only by our astounding theoretical progress in sound knowledge of Nature, but also by the remarkably fertile practical application of that knowledge in technical science, industry, commerce, and so forth. On the other hand, however, we have made little or no progress in moral and social life, in comparison with earlier centuries; at times there has been serious reaction. And from this obvious conflict there have arisen, not only an uneasy sense of dismemberment and falseness, but even the danger of grave catastrophes in the political and social world. It is, then, not merely the right, but the sacred duty, of every honorable and humanitarian thinker to devote himself conscientiously to the settlement of that conflict, and to warding off the dangers that it brings in its train.—HAECKEL *Riddle of the Universe*, ch. 1, p. 1. (H., 1900.)

474. CHANGES AMONG THE STARS—*Increase and Decrease of Brightness.*—In this long and careful series of observations it has been remarked that the stars are not fixed or unalterable, as they appear to be. There are some which since the time of Hipparchus have slowly diminished in brightness, and have even ended by becoming completely extinct. There are others whose light has gradually increased, and which are now much brighter than they were formerly.

Others, again, have changed in tint. . . . There are some, also, which have suddenly appeared, have shone with a dazzling brightness for several weeks or months, and have then relapsed into obscurity. In a large number a periodical variation of light has been established, in virtue of which certain stars, at first invisible to the naked eye, appear, increase progressively in brightness, then gradually diminish, and disappear, to again reappear after a certain number of days has elapsed; their periodicity is sometimes so exact that they are now calculated in advance.—FLAMMARION *Popular Astronomy*, bk. vi, ch. 3, p. 580. (A.)

475. CHANGES IN SHAPE OF THE EARTH—*Alps Thrust Up from beneath the Sea—Folded and Contorted Strata.*—That [the Alps] were in whole or in part once beneath the sea will not be disputed; for they are in great part composed of sedimentary rocks which required a sea to form them. Their present elevation above the sea is due to one of those local changes in the shape of the earth which have been of frequent occurrence throughout geologic time, and which in some cases have depressed the land, and in others caused the sea-bottom to protrude beyond its surface. Considering the inelastic character of its materials, the protuberance of the Alps could hardly have been pushed out without dislocation and fracture; and this conclusion gains in probability when we consider the foldings, contortions, and even reversals in position of the strata in many parts of the Alps. Such changes in the position of beds which were once horizontal could not have been effected without dislocation.—TYNDALL *Hours of Exercise in the Alps*, ch. 20, p. 230. (A., 1898.)

476. CHANGES IN STRUCTURE OF THE EARTH—*Rapid Growth of Coral.*—It may be concluded, first, that considerable thicknesses of rock have certainly been formed within the present geological era by the growth of corals and the accumulation of their detritus; and, secondly, that the increase of individual corals and of reefs, both outwards or horizontally, and upwards or vertically, under conditions favorable to such increase, is not slow, when referred either to the standard of the average oscillations of level in the earth's crust, or to the more precise but less important one of a cycle of years.—DARWIN *Coral Reefs*, ch. 4, p. 107. (A., 1900.)

477. CHANGES IN THE BRAIN—*Present State a Combined Result of Circumstance and Sensibility.*—Whilst we think, our brain changes, and, like the aurora borealis, its whole internal equilibrium shifts with every pulse of change. The precise nature of the shifting at a given moment is a product of many factors. The accidental state of local nutrition or blood-supply may be among them. But just as one of them certainly is the influence of outward objects on the sense-organs during the moment, so is another certainly the very special susceptibility in which the organ has been left at that moment by all it has gone through in the past. Every brain-state is partly determined by the nature of this entire past succession. Alter the latter in any part, and the brain-state must be somewhat different. Each present brain-state is a record in which the eye of Omniscience might read all the foregone history of its owner.—JAMES *Psychology*, vol. i, ch. 9, p. 234. (H. H. & Co., 1899.)

478. CHANGES, MOLECULAR, IN PLANTS DUE TO LIGHT—*Colors of Flower Petals—Chlorophyl Produced by Sun.*—Light is an all-important agent of molecular changes in organic substances. . . . The characteristic matter called chlorophyl, which gives the green color to leaves, makes its appearance whenever the blanched shoots of plants are exposed to the sun; the petals of flowers, uncolored while in the bud, acquire their bright tints as they unfold; and on the outer surfaces of animals analogous changes are induced.—SPENCER *Biology*, pt. i, ch. 2, p. 35. (A., 1900.)

479. CHANGES OF A STAR — *Once Bright as Sirius, Now Almost Invisible.*—Changes such as these [the repeated increase and decline of light of a star in the ship Argo]—or even one of these changes—if occurring in the case of our own sun, would destroy life very quickly from the face of the earth, and probably from all the inhabited planets of the solar system. The mere change from the second magnitude to a brightness approaching that of Sirius implies an increase of emission of light and heat more than tenfold. But from this amazing access of splendor how wonderful has been the falling off by which the star has been rendered almost invisible. It is absolutely certain that this star, once doubtless a sun, and probably, like our own sun, the center of a scheme of circling worlds, gives out, day by day, far less than the hundredth part of the light and heat which it gave out daily only thirty years ago.—PROCTOR *Expanse of Heaven*, p. 197. (L. G. & Co., 1897.)

480. CHANGES, SUBTERRANEAN—*Defy Human Perception—Imagination Often at Fault—Prejudices Arising from Our Not Seeing Subterranean Changes.*—Nor is his [man's] position less unfavorable when, beholding a volcanic eruption, he tries to conceive what changes the column of lava has produced, in its passage upwards, on the intersected strata; or what form the melted matter may assume at great depths on cooling; or what may be the extent of the subterranean rivers and reservoirs of liquid matter far beneath the surface. It should therefore be remembered that the task imposed on those who study the earth's history requires no ordinary share of discretion; &c

we are precluded from collating the corresponding parts of the system of things as it exists now, and as it existed at former periods. If we were inhabitants of another element—if the great ocean were our domain, instead of the narrow limits of the land—our difficulties would be considerably lessened; while, on the other hand, there can be little doubt, altho the reader may perhaps smile at the bare suggestion of such an idea, that an amphibious being who should possess our faculties would still more easily arrive at sound theoretical opinions in geology, since he might behold, on the one hand, the decomposition of rocks in the atmosphere, or the transportation of matter by running water; and, on the other, examine the deposition of sediment in the sea, and the embedding of animal and vegetable remains in new strata. He might ascertain, by direct observation, the action of a mountain torrent, as well as of a marine current; might compare the products of volcanoes poured out upon the land with those ejected beneath the waters; and might mark, on the one hand, the growth of the forest, and, on the other, that of the coral reef. Yet, even with these advantages, he would be liable to fall into the greatest errors, when endeavoring to reason on rocks of subterranean origin. He would seek in vain, within the sphere of his observation, for any direct analogy to the process of their formation, and would therefore be in danger of attributing them, wherever they are upraised to view, to some "primeval state of Nature."—LYELL *Principles of Geology*, ch. 5, p. 69. (A., 1854.)

481. CHARACTER A SUM OF ACTIVITIES—*Every Action Counts—Hell a Present Fact in Evil Life.*—The hell to be endured hereafter, of which theology tells, is no worse than the hell we make for ourselves in this world by habitually fashioning our characters in the wrong way. Could the young but realize how soon they will become mere walking bundles of habits, they would give more heed to their conduct while in the plastic state. We are spinning our own fates, good or evil, and never to be undone. Every smallest stroke of virtue or of vice leaves its never so little scar. The drunken Rip Van Winkle, in Jefferson's play, excuses himself for every fresh dereliction by saying, "I won't count this time!" Well! he may not count it, and a kind Heaven may not count it; but it is being counted none the less. Down among his nerve-cells and fibers the molecules are counting it, registering and storing it up to be used against him when the next temptation comes. Nothing we ever do is, in strict scientific literalness, wiped out. Of course, this has its good side as well as its bad one. As we become permanent drunkards by so many separate drinks, so we become saints in the moral, and authorities and experts in the practical and scientific spheres, by so many separate acts and hours of work.—JAMES *Psychology*, vol. i, ch. 4, p. 127. (H. H. & Co., 1899.)

482. CHARACTER, FORMATION OF—*Development of the Will.*—Whilst, in its earlier stages, the educator aims to call forth and train the intellectual faculties of his pupil, and to form his moral character, by bringing appropriate external influences to bear upon him, every one who really understands his profession will make it his special object to foster the development, and to promote the right exercise, of that internal power, by the exertion of which each individual becomes the director of his own conduct, and so far the arbiter of his own destinies. This power is exercised by the will, in virtue of its domination over the automatic operations of the mind, as over the automatic movements of the body; the real self-formation of the ego commencing with his consciousness of the ability to determine his own course of thought and action. Until this self-directing power has been acquired, the character is the resultant of the individual's original constitution, and of the circumstances in which he may have been placed; and so long as the circumstances are unfavorable to its development, and to the operation of those higher tendencies which should furnish the best motives to its exercise, so long the character of the individual is formed for him rather than by him.—CARPENTER *Mental Physiology*, bk. i, ch. 1, sec. 8, p. 9. (A., 1900.)

483. CHEAPENING OF LABOR—*Women and Children Made Victims—Legislation Must Control Rapacity.*—"Thus," says Mr. Baker, one of the most experienced of our factory inspectors, "most of the workshops of this great commercial country are found to have fallen into the inevitable track of competitive industry, when unrestricted by law—namely, to cheapen prices by the employment of women and children, in the first instance, and then to increase production by protracted hours of work, without much regard to age, to sex, or to physical capability." This is the result of nature—of nature, at least, such as ours now is. But it is the result of that nature with all its nobler powers allowed to sleep. Power to control such evils has been given to man, and he is bound to use it. "Free labor, even in a free country," as Mr. Baker says, "requires the strong arm of the law to protect it from the cupidity and ignorance of parents." And by the "strong arm of the law" is meant nothing but the law of conscience and of reason asserting itself over the lower instincts of our nature. If under such conditions of society higher motives are ever to prevail, they must be supplied from without, and must be imposed in authoritative form through the legitimate organs of positive institution.—ARGYLL *Reign of Law*, ch. 7, p. 214. (Burt.)

484. CHECKS UPON INCREASE OF WEEDS — Seedlings, also, are destroyed in vast numbers by various enemies; for instance, on a piece of ground three feet long and two wide, dug and cleared, and where there could be no choking from other plants, I marked all the seedlings of our native weeds as they came up, and out of 357 no less than 295 were destroyed, chiefly by slugs and insects.—DARWIN *Origin of Species*, ch. 1, p. 63. (Burt.)

485. CHEMISTRY DEVELOPED BY ARABS—*Debt of Science to Moslem Investigators.*—The most powerful influence exercised by the Arabs on general natural physics was that directed to the advances of chemistry, a science for which this race created a new era. It must be admitted that alchemistic and new Platonic fancies were as much blended with chemistry as astrology with astronomy. The requirements of pharmacy, and the equally urgent demands of the technical arts, led to discoveries which were promoted, sometimes designedly, and sometimes by a happy accident depending upon alchemistic investigation into the study of metallurgy. The labors of Geber and the much more recent ones of Razes have been attended by the most important results. This period is characterized by the preparation of sulfuric and nitric acids, aqua regia, preparations of mercury, and of the oxids of other metals, and by the knowledge of the alcoholic process of fermentation. The first scientific foundation, and the subsequent advances of chemistry, are so much the more important, as they imparted a knowledge of the heterogeneous character of matter, and the nature of forces not made manifest by motion, but which now led to the recognition of the importance of composition, no less than to that of the perfectibility of form assumed in accordance with the doctrines of Pythagoras and Plato. Differences of form and of composition are, however, the elements of all our knowledge of matter—the abstractions which we believe capable, by means of measurement and analysis, of enabling us to comprehend the whole universe.—HUMBOLDT *Cosmos*, vol. ii, pt. ii p. 217. (H., 1897.)

486. CHEMISTRY, MODERN, ELEVATES WORK AND WORKER—*Intelligence in the Kitchen.*—Modern chemistry can throw into the kitchen a great deal of light that shall not merely help the cook in doing his or her work more efficiently, but shall also elevate both the work and the worker, and render the kitchen far more interesting, to all intelligent people who have an appetite for knowledge, as well as for food; more so than it can be while the cook is groping in rule-of-thumb darkness—is merely a technical operator unenlightened by technological intelligence.—WILLIAMS *Chemistry of Cookery*, ch. 1, p. 5. (A., 1900.)

487. CHILD A TUTOR FOR THE AFFECTIONS—*The Lengthening of School-days—Giving Affection Time to Grow.*—No greater day ever dawned for evolution than this on which the first human child was born. For there entered then into the world the one thing wanting to complete the ascent of man—a tutor for the affections. It may be that a mother teaches a child, but in a far deeper sense it is the child who teaches the mother. . . . To create motherhood and all that enshrines itself in that holy word required a human child. The creation of the mammalia established two schools in the world—the two oldest and surest and best equipped schools of ethics that have ever been in it—the one for the child, who must now at least know its mother; the other for the mother, who must as certainly attend to her child. The only thing that remains now is to secure that they shall both be kept in that school as long as it is possible to detain them. The next effort of evolution, therefore—the fifth process, as one might call it—is to lengthen out these school-days, and give affection time to grow. —DRUMMOND *Ascent of Man*, p. 281. (J. P., 1900.)

488. CHILD BELIEVES IN SPONTANEOUS GENERATION — *Childhood of the Race.*—The most copious source of this life without an ancestry was putrefying flesh; and, lacking the checks imposed by fuller investigation, the conclusion that flesh possesses and exerts this generative power is a natural one. I well remember, when a child of ten or twelve, seeing a joint of imperfectly salted beef cut into, and coils of maggots laid bare within the mass. Without a moment's hesitation I jumped to the conclusion that these maggots had been spontaneously generated in the meat. I had no knowledge which could qualify or oppose this conclusion, and for the time it was irresistible. The childhood of the individual typifies that of the race, and the belief here enunciated was that of the world for nearly two thousand years.—TYNDALL *Fragments of Science*, vol. ii, ch. 13, p. 291. (A., 1900.)

489. CHILD-TRAINING, NEED OF A SCIENCE OF — The principles of the mental culture of children especially can be outlined without trouble. We have a sufficiency of pedagogic models, almost in greater number than we have in dietetics or hygiene. And a young mother could look upon her babe with much more assurance if she were not obliged to acknowledge that this child of hers was to be an experiment—one on which, with more or less independence, and according to her own starts of fancy, she would make her experiments in training. For— let us not blind ourselves to the fact—our family training still remains upon the same low plane as political economy in the preceding century; it is purely natural economy. It should be the mission of our times to develop the science of bringing up children, and to put it into application, and to do away with this continual experimenting,

this training of children according to mere tradition.—VIRCHOW *Ueber die Erziehung des Weibes für seinen Beruf*, p. 27. (Translated for *Scientific Side-Lights.)*

490. CHOICE AMONG METHODS OF REACHING A SINGLE END—*A Superior Intelligence Can Predetermine Results, while Leaving Inferior Intelligence Free.*—Not infrequently the one thing willed, as the only end before the mind, may be accomplished in either one of several ways. Thus a skilled fencer who has willed to attack his opponent at what he knows to be his only weak point, and under the influence of this volition is watching his opportunity, may with incredible speed, and yet with conscious intelligent choice, select the particular form of giving his thrust—some new trick he has recently learned.—LADD *Psychology*, ch. 26, p. 630. (S., 1899.)

491. CHOICE THE GREAT WORK OF CONSCIOUSNESS — Consciousness is at all times primarily a selecting agency. Whether we take it in the lowest sphere of sense or in the highest of intellection, we find it always doing one thing, choosing one out of several of the materials so presented to its notice, emphasizing and accentuating that and suppressing as far as possible all the rest. The item emphasized is always in close connection with some interest felt by consciousness to be paramount at the time. —JAMES *Psychology*, vol. i, ch. 5, p. 139. (H. H. & Co., 1899.)

492. CHOICE THE RESULT OF A SERIES OF COMPARISONS—*Decision the Result of What One Brings to the Test.*—How is it when an alternative is presented to you for choice, and you are uncertain what you ought to do? You first hesitate, and then you deliberate. And in what does your deliberation consist? It consists in trying to apperceive the case successively by a number of different ideas, which seem to fit it more or less, until at last you hit on one which seems to fit it exactly. If that be an idea which is a customary forerunner of action in you, which enters into one of your maxims of positive behavior, your hesitation ceases, and you act immediately. If, on the other hand, it be an idea which carries inaction as its habitual result, if it ally itself with prohibition, then you unhesitatingly refrain. The problem is, you see, to find the right idea or conception for the case.—JAMES *Talks to Teachers*, ch. 15, p. 184. (H. H. & Co., 1900.)

493. CHRISTIANITY DEMANDS NO EXCEPTION TO LAW — *Christ's Work a Means to an End.*—Assuredly, whatever may be the difficulties of Christianity, this is not one of them—that it calls on us to believe in any exception to the universal prevalence and power of law. Its leading facts and doctrines are directly connected with this belief, and directly suggestive of it. The divine mission of Christ on earth—does not this imply not only the use of means to an end, but some inscrutable necessity that certain means, and these only, should be employed in resisting and overcoming evil? What else is the import of so many passages of Scripture implying that certain conditions were required to bring the Savior of man into a given relation with the race he was sent to save? "It behoved him . . . to make the captain of our salvation perfect through suffering." "It behoved him in all things to be made like unto his brethren, that he might be," etc.—with the reason added: "for in that he himself hath suffered being tempted, he is able to succour them that are tempted." Whatever more there may be in such passages, they all imply the universal reign of law in the moral and spiritual, as well as in the material world: that those laws had to be—behooved to be—obeyed; and that the results to be obtained are brought about by the adaptation of means to an end, or, as it were, by way of natural consequences from the instrumentality employed. This, however, is an idea which systematic theology generally regards with intense suspicion, tho, in fact, all theologies involve it, and build upon it.—ARGYLL *Reign of Law*, ch. 1, p. 31. (Burt.)

494. CHRISTIANITY LED TO STUDY OF NATURE—*Religion Ministers to Science.*—At the period when the feelings died away which had animated classical antiquity, and directed the minds of men to a visible manifestation of human activity rather than to a passive contemplation of the external world, a new spirit arose; Christianity gradually diffused itself, and, wherever it was adopted as the religion of the state, it not only exercised a beneficial influence on the condition of the lower classes by inculcating the social freedom of mankind, but also expanded the views of men in their communion with Nature. The eye no longer rested on the forms of Olympic gods. The Fathers of the Church, in their rhetorically correct and often poetically imaginative language, now taught that the Creator showed himself great in inanimate no less than in animate nature, and in the wild strife of the elements no less than in the still activity of organic development. . . . The ancient world is not abruptly separated from the modern, but modifications in the religious sentiments and the tenderest social feelings of men, and changes in the special habits of those who exercise an influence on the ideas of the mass, must give a sudden predominance to that which might previously have escaped attention. It was the tendency of the Christian mind to prove from the order of the universe and the beauty of Nature the greatness and goodness of the Creator. This tendency to glorify the Deity in his works gave rise to a taste for natural description. The earliest and most remarkable instances of this kind are to be met with in the writings of Minucius Felix, a rhetorician and lawyer at Rome, who lived in the beginning of the third century. . . .

We follow with pleasure the delineation of his twilight rambles on the shore near Ostia, which he describes as more picturesque and more conducive to health than we find it in the present day. In the religious discourse entitled "Octavius" we meet with a spirited defense of the new faith against the attacks of a heathen friend.—HUMBOLDT *Cosmos*, vol. ii, pt. i, p. 38. (H., 1897.)

495. CHRISTIANITY UNSHAKEN BY COPERNICAN ASTRONOMY—*Religion Has Outgrown the Ancient Cosmic Theories.*—It is instructive to observe that, while the Copernican astronomy has become firmly established in spite of priestly opposition, the foundations of Christian theology have not been shaken thereby. It is not that the question which once so sorely puzzled men has ever been settled, but that it has been outgrown. The speculative necessity for man's occupying the largest and most central spot in the universe is no longer felt. It is recognized as a primitive and childish notion. With our larger knowledge we see that these vast and fiery suns are after all but the Titan-like servants of the little planets which they bear with them in their flight through the abysses of space. . . . And as when God revealed himself to his ancient prophet he came, not in the earthquake or the tempest, but in a voice that was still and small, so that divine spark the soul, as it takes up its brief abode in this realm of fleeting phenomena, chooses not the central sun where elemental forces forever blaze and clash, but selects an outlying terrestrial nook where seeds may germinate in silence, and where through slow fruition the mysterious forms of organic life may come to take shape and thrive.—FISKE *Destiny of Man*, ch. 1, p. 16. (H. M. & Co., 1900.)

496. CHROMOSPHERE OF THE SUN—*Eclipses of 1842 and 1851—The Solar "Prominences."*—In July, 1842, a great eclipse occurred, and the shadow of the moon described a wide belt running across southern France, northern Italy, and a portion of Austria. The eclipse was carefully observed by many of the most noted astronomers of the world: and so completely had previous observations of the kind been forgotten, that the prominences, which appeared then with great brilliance, were regarded with extreme surprise, and became objects of warm discussion, not only as to their cause and location, but even as to their very existence. Some thought them mountains upon the sun, some that they were solar flames, and others, clouds floating in the sun's atmosphere. Others referred them to the moon, and yet others claimed that they were mere optical illusions. At the eclipse of 1851 (in Sweden and Norway), similar observations were repeated, and, as a result of the discussions and comparison of observations which followed, astronomers generally became satisfied that the prominences are real phenomena of the solar atmosphere, in many respects analogous to our terrestrial clouds; and several came more or less confidently to the conclusion, now known to be true, that the sun is entirely surrounded with a continuous stratum of the same substance.—YOUNG *The Sun*, ch. 6, p. 105. (A., 1898.)

497. CIRCULATION ON THE SUN—*Products Cooled on the Surface Poured Back for Reheating—Otherwise All on Earth Would Die—Spots That Seem to Dim the Glory Are the Very Source of Life.*—"Are the spots, these gigantic areas of disturbance, comparable to whirlpools or to volcanoes?" It may seen unphilosophical to assume that they are one or the other, and in fact they may possibly be neither; but it is certain that the surface of the sun would soon cool from its enormous temperature, if it were not supplied with fresh heat, and it is almost certain that this heat is drawn from the interior. As M. Faye has pointed out, there must be a circulation up and down, the cooled products being carried within, heated and brought out again, or the sun would, however hot, grow cold outside; and, what is of interest to us, the earth would grow cold also, and we should all die. No one, I believe, who has studied the subject, will contradict the statement that if the sun's surface were absolutely cut off from any heat-supply from the interior, organic life in general upon the earth (and our own life in particular) would cease much within a month. This solar circulation, then, is of nearly as much consequence to us as that of our own bodies, if we but knew it.—LANGLEY *New Astronomy*, ch. 1, p. 28. (H. M. & Co., 1896.)

498. CIVILIZATION A GAIN—*The Poor, as a Rule, Better Fed than Savages.*—To uncivilized men supplies of food come very irregularly. Long periods of scarcity are divided by short periods of abundance. And tho by gorging when opportunity occurs, something is done towards compensating for previous fasting, yet the effects of prolonged starvation cannot be neutralized by occasional enormous meals. Bearing in mind, too, that, improvident as they are, savages often bestir themselves only under pressure of hunger, we may fairly consider them as habitually ill-nourished—may see that even the poorer classes of civilized men, making regular meals on food separated from innutritive matters, easy to masticate and digest, tolerably good in quality, and adequate if not abundant in quantity, are much better nourished.—SPENCER *Biology*, pt. vi, ch. 12, p. 515. (A., 1900.)

499. CIVILIZATION, ANCIENT—*Encumbered by Relics of Barbarism—Evidences of Slow Advance—Hieroglyphics—Dog and Cat Worship.*—These, then [the Egyptians and Babylonians], are the two nations whose culture is earliest vouched for by inscriptions done at the very time of their ancient gran-

deur, and therefore it is safer to appeal to them than to other nations which can only show as proofs of their antiquity writings drawn up in far later ages. Looking at their ancient civilization, it seems to have been formed by men whose minds worked much like our own. No superhuman powers were required for the work, but just human nature groping on by roundabout ways, reaching great results, yet not half knowing how to profit by them when reached; solving the great problem of writing, yet not seeing how to simplify the clumsy hieroglyphics into letters; devoting earnest thought to religion and yet keeping up a dog and cat worship which was a jest even to the ancients; cultivating astronomy and yet remaining mazed in the follies of astrology. —TYLOR *Anthropology*, ch. 1, p. 22. (A., 1899.)

500. ——— ——— *Shows Traces of More Remote Antiquity—Prehistoric Development and Progress.*—In the midst of their [Egyptians and Babylonians] most striking efforts of civilization, the traces may be discerned of the barbaric condition which prevailed before; the Egyptian pyramids are burial-mounds like those of prehistoric England, but huge in size and built of hewn stone or brick; the Egyptian hieroglyphics, with their pictures of men and beasts and miscellaneous things, tell the story of their own invention, how they began as a mere picture-writing, like that of the rude hunters of America. Thus it appears that civilization, at the earliest dates where history brings it into view, had already reached a level which can only be accounted for by growth during a long prehistoric period. This result agrees with the conclusions already arrived at by the study of races and language.—TYLOR *Anthropology*, ch. 1, p. 22. (A., 1899.)

501. CIVILIZATION CAME TO EUROPE FROM WITHOUT—*Archeology Tells the Story—Fixing a Relative Date.*—When metals were very scarce, it would naturally sometimes happen that, in order to make up the necessary quantity, some tin would be added to copper, or vice versa. It would then be found that the properties of the alloy were quite different from those of either metal, and a very few experiments would determine the most advantageous proportion, which for axes and other cutting instruments is about nine parts of copper to one of tin. No implements or weapons of tin have yet been found, and those of copper are extremely rare, in western Europe, whence it has been inferred that the art of making bronze was known elsewhere before the use of either copper or tin was introduced into Europe.—AVEBURY *Prehistoric Times*, ch. 1, p. 4. (A., 1900.)

502. CIVILIZATION, CULTURE THE RIPE FRUIT OF—*Pioneer Too Hard Driven for Abstractions.*—**When the Pilgrim Fathers landed at Plymouth Rock, and when Penn made his treaty with the Indians, the newcomers had to build their houses, to chasten the earth into cultivation, and to take care of their souls. In such a community, science, in its more abstract forms, was not to be thought of. And at the present hour, when your hardy Western pioneers stand face to face with stubborn Nature, piercing the mountains and subduing the forest and the prairie, the pursuit of science, for its own sake, is not to be expected. The first need of man is food and shelter; but a vast portion of this continent is already raised far beyond this need. The gentlemen of New York, Brooklyn, Boston, Philadelphia, Baltimore, and Washington have already built their houses, and very beautiful they are; they have also secured their dinners, to the excellence of which I can also bear testimony. They have, in fact, reached that precise condition of well-being and independence when a culture, as high as humanity has yet reached, may be justly demanded at their hands. They have reached that maturity, as possessors of wealth and leisure, when the investigator of natural truth, for the truth's own sake, ought to find among them promoters and protectors.—TYNDALL *Lectures on Light*, p. 224. (A., 1898.)**

503. CIVILIZATION, DECLINE OF—*The Half-castes of India—The Digger Indians of North America.*—Degeneration is to be seen among the descendants of Portuguese in the East Indies, who have intermarried with the natives and fallen out of the march of civilization, so that newly arrived Europeans go to look at them lounging about their mean hovels in the midst of luxuriant tropical fruits and flowers, as if they had been set there to teach by example how man falls in culture where the need of effort is wanting. Another frequent cause of loss of civilization is when people once more prosperous are ruined or driven from their homes, like those Shoshone Indians who have taken refuge from their enemies, the Blackfeet, in the wilds of the Rocky Mountains, where they now roam, called Digger Indians, from the wild roots they dig for as part of their miserable subsistence. Not only the degraded state of such outcasts, but the loss of particular arts by other peoples, may often be explained by loss of culture under unfavorable conditions. —TYLOR *Anthropology*, ch. 1. p. 19. (A., 1899.)

504. ——— ——— *The South Sea Islanders Planting Nails—Lost Arts.*—The South Sea Islanders, tho not a very rude people when visited by Captain Cook, used only stone hatchets and knives, being indeed so ignorant of metal that they planted the first iron nails they got from the English sailors, in the hope of raising a new crop. Possibly their ancestors never had metals, but it seems as likely that these ancestors were an Asiatic people to whom metal was

known, but who, through emigration to ocean islands and separation from their kinsfolk, lost the use of it and fell back into the Stone Age. It is necessary for the student to be alive to the importance of decline in civilization.—TYLOR *Anthropology*, ch. 1, p. 19. (A., 1899.)

505. CIVILIZATION FAILS TO TEACH HUMANITY—*Extermination of Animals—Our Domestic Species Spared by Ancient Barbarians.*—It is sad to reflect that all our domestic animals have descended to us from those ancient times which we are accustomed to regard as dark or barbarous, while the effect of our modern so-called humane civilization has been purely destructive to animal life. Not one type do we rescue from the carnage going on at an ever-increasing rate over all the globe. To Australia and America, North and South, we look in vain for new domestic species, while even from Africa, with its numerous fine mammalian forms, and where England has been the conquering colonizing power for nearly a century, we take nothing. Even the sterling qualities of the elephant, the unique beauty of the zebra, appeal to us in vain. We are only teaching the tribes of that vast continent to exterminate a hundred noble species they would not tame. With grief and shame, even with dismay, we call to mind that our country is now a stupendous manufactory of destructive engines, which we are rapidly placing in the hands of all the savage and semi-savage peoples of the earth, thus insuring the speedy destruction of all the finest types in the animal kingdom.—HUDSON *Naturalist in La Plata*, ch. 17, p. 233. (C. & H., 1895.)

506. CIVILIZATION FOUNDED UPON HOME—*Influence of a Fixed Abode.*—What a simple fact and what a simple idea a house seems to be. To one it is a possession, to another wealth; to one nothing but property, to another only an investment. And yet with the house a new form was given to the entire world's history. There have been houseless peoples capable of making inroads into the world's history with elementary power, that have won great battles, overthrown empires and destroyed them. But they were not able to accomplish anything lasting until the wild riders and hunters from the forest and the wilderness built for themselves a hearth, or made themselves at home in what they had conquered. It was first with the home that the general civilization began, with the domestic life of the individual, the civilization of the individual. —STEIN *Die Frau auf dem Gebiete der Nationalökonomie. A Lecture.* (Translated for *Scientific Side-Lights.*)

507. CIVILIZATION IN NORTHERN LANDS—*Diversity and Interest of Northern Life—Abundance of Tropics Favors Indolence and Improvidence—Possible Future of Humanity under the Equator.*—During this last night on the Pará River a crowd of unusual thoughts occupied my mind. Recollections of English climate, scenery, and modes of life came to me with a vividness I had never before experienced during the eleven years of my absence. Pictures of startling clearness rose up of the gloomy winters, the long gray twilights, murky atmosphere, elongated shadows, chilly springs, and sloppy summers; of factory chimneys and crowds of grimy operatives, rung to work in early morning by factory bells; of union workhouses, confined rooms, artificial cares, and slavish conventionalities. To live again amid these dull scenes I was quitting a country of perpetual summer, where my life had been spent, like that of three-fourths of the people, in gipsy fashion, on the endless streams or in the boundless forests. I was leaving the equator, where the well-balanced forces of Nature maintained a land-surface and climate that seemed to be typical of mundane order and beauty, to sail toward the north pole, where lay my home under crepuscular skies somewhere about fifty-two degrees of latitude. It was natural to feel a little dismayed at the prospect of so great a change; but now, after three years of renewed experience of England, I find how incomparably superior is civilized life, where feelings, tastes, and intellect find abundant nourishment, to the spiritual sterility of half-savage existence, even tho it be passed in the Garden of Eden. What has struck me powerfully is the immeasurably greater diversity and interest of human character and social conditions in a single civilized nation than in equatorial South America, where three distinct races of men live together. The superiority of the bleak north to tropical regions, however, is only in their social aspect; for I hold to the opinion that, altho humanity can reach an advanced state of culture only by battling with the inclemencies of Nature in high latitudes, it is under the equator alone that the perfect race of the future will attain to complete fruition of man's beautiful heritage, the earth.—BATES *The Naturalist on the River Amazon*, ch. 13, p. 773. (Hum., 1880.)

508. CIVILIZATION, IN WHAT DOES IT CONSIST?—An extended knowledge of the useful arts, and the possession of such a settled system of law and government as enables men to live in great political communities, these are the essential features of what we understand by civilization.—ARGYLL *Unity of Nature*, ch. 10, p. 225. (Burt.)

509. CIVILIZATION NOT COMPLETED BY MATERIAL GOOD—*Spiritual Advance Its Goal—The Body the Vehicle for the Soul.*—If we can imagine a future time when warfare and crime shall have been done away with forever, when disease shall have been for the most part curbed, and when every human being by moderate labor can secure ample food and shelter, we can also see that in such a state of things the

work of civilization would be by no means completed. In ministering to human happiness in countless ways, through the pursuit of purely spiritual ends, in enriching and diversifying life to the utmost, there would still be almost limitless work to be done. I believe that such a time will come for weary and suffering mankind. Such a faith is inspiring. It sustains one in the work of life, when one would otherwise lose heart. But it is a faith that rests upon induction. The process of evolution is excessively slow, and its ends are achieved at the cost of enormous waste of life, but for innumerable ages its direction has been toward the goal here pointed out; and the case may be fitly summed up in the statement that whereas in its rude beginnings the psychical life was but an appendage to the body, in fully developed humanity the body is but the vehicle for the soul.—FISKE *Destiny of Man*, ch. 8, p. 64. (H. M. & Co., 1900.)

510. CIVILIZATION REMOVES OCCASIONS FOR FEAR — The progress from brute to man is characterized by nothing so much as by the decrease in frequency of proper occasions for fear. In civilized life, in particular, it has at last become possible for large numbers of people to pass from the cradle to the grave without ever having had a pang of genuine fear. Many of us need an attack of mental disease to teach us the meaning of the word. Hence the possibility of so much blindly optimistic philosophy and religion. The atrocities of life become "like a tale of little meaning, tho the words are strong"; we doubt if anything like us ever really was within the tiger's jaws, and conclude that the horrors we hear of are but a sort of painted tapestry for the chambers in which we lie so comfortably at peace with ourselves and with the world.—JAMES *Psychology*, vol. ii, ch. 24, p. 415. (H. H. & Co., 1899.)

511. CIVILIZATION TEACHES REGULAR WORK—*Savage Requires Excitement.*—We naturally assume that because barbarians are averse to regular labor their muscular action is less than our own. But this is not necessarily true. The monotonous toil is what they cannot tolerate; and they may be ready to go through as much or more exertion when it is joined with excitement. If we remember that the sportsman who gladly scrambles up and down rough hillsides all day after grouse or deer, would think himself hardly used had he to spend as much effort and time in digging; we shall see that a savage who is the reverse of industrious, may nevertheless be subject to a muscular waste not very different in amount from that undergone by the industrious.—SPENCER *Biology*, pt. vi, ch. 12, p. 515. (A., 1900.)

512. CIVILIZATION, THE DWELLING AN INDEX OF—In general, the dwelling provides an instrument for measuring the degree of civilization a people has attained. —ALSBERG *Die gesunde Wohnung*. (Translated for *Scientific Side-Lights.)*

513. CLASSIFICATION, BACTERIA ELUDE—Even yet, however, we are far from a scientific classification for bacteria. Nor is this matter for surprise. The development in this branch of biology has been so rapid that it has been impossible to assimilate the facts collected. The facts themselves by their remarkable variety have not aided classification. Names which a few years ago were applied to individual species are now representative, not of individuals, but of families and groups of species. Again, isolated characteristics of certain microbes, such as motility, power of liquefying gelatin, size, color, and so forth, which at first sight might appear as likely to form a basis for classification, are found to vary not only between similar germs, but in the same germ. Different physical conditions have so powerful an influence upon these microscopic cells that their individual characters are constantly undergoing change. For example, bacteria in old cultures assume a different size, and often a different shape, from younger members of precisely the same species. . . . Hence it will at once appear to the student of bacteriology that, tho there is great need for classification amongst the six or seven hundred species of microbes, our present knowledge of their life-history is not yet advanced enough to form more than a provisional arrangement.—NEWMAN *Bacteria*, ch. 1, p. 7. (G. P. P., 1899.)

514. CLASSIFICATION DEPENDENT UPON PURPOSE — It is always easy to find fault with a classification. There are a hundred possible ways of arranging any set of objects, and something may almost always be said against the best and in favor of the worst of them. But the merits of a classification depend on the purposes to which it is instrumental.—MILL *Positive Philosophy of Auguste Comte*, p. 40. (H. H. & Co., 1887.)

515. CLEANLINESS SECURES PURITY OF MILK—*Gross Pollution under Ordinary Conditions.*—Professor Russell [in "Dairy Bacteriology," p. 46] recounts a simple experiment [as follows]:

"A cow that had been pastured in a meadow was taken for the experiment, and the milking done out-of-doors, to eliminate as much as possible the influence of germs in the barn air. Without any special precaution being taken the cow was partially milked, and during the operation a covered glass dish, containing a thin layer of sterile gelatin, was exposed for sixty seconds underneath the belly of the cow in close proximity to the milk-pail. The udder, flank, and legs of the cow were then thoroughly cleaned with water, and all of the precautions referred to before were carried out, and the milking then resumed. A second

plate was then exposed in the same place for an equal length of time, a control also being exposed at the same time at a distance of ten feet from the animal and six feet from the ground to ascertain the germ contents of the surrounding air. From this experiment the following instructive data were gathered. Where the animal was milked without any special precautions being taken there were 3,250 bacterial germs per minute deposited on an area equal to the exposed top of a ten-inch milk-pail. Where the cow received the precautionary treatment as suggested above, there were only 115 germs per minute deposited on the same area. In the plate that was exposed to the surrounding air at some distance from the cow there were 65 bacteria. This indicates that a large number of organisms from the dry coat of the animal can be kept out of milk if such simple precautions as these are carried out."—NEWMAN *Bacteria*, ch. 6, p. 182. (G. P. P., 1899.)

516. CLEANLINESS, UTILITY OF, DISCOVERED WHILE REASONS WERE UNKNOWN—To the credit of English surgeons it stands recorded that, guided by their practical sagacity, they had adopted in their hospitals measures of amelioration which reduced, almost to a minimum, the rate of mortality arising from the "mortification" of wounds. They had discovered the evils incident to "dirt"; and, by keeping dirt far away from them, they had saved innumerable lives, which would undoubtedly have succumbed under conditions prevalent in many of the hospitals of continental Europe. In thus acting, English surgeons were, for the most part, "wiser than they knew." Their knowledge, however momentous in its practical applications, was still empirical knowledge. That dirt was fatal they had discovered; but why it was fatal few of them knew.—TYNDALL *Floating Matter of the Air*, int., p. 7. (A., 1895.)

517. CLEANLINESS, UTILITY OF, SCIENTIFICALLY DEMONSTRATED—*Lister and Schwann Proved Germs to Be Deadly.*—At this point Lister came forward with a scientific principle which rendered all plain. Dirt was fatal, not as dirt, but because it contained living germs which, as Schwann was the first to prove, are the cause of putrefaction. Lister extended the generalization of Schwann from dead matter to living matter, and by this apparently simple step revolutionized the art of surgery. He changed it, in fact, from an art into a science.—TYNDALL *Floating Matter of the Air*, int., p. 8. (A., 1895.)

518. CLEARNESS OF THE CELESTIAL ETHER—*Contrast with the Atmosphere of Earth.*—It is marvelous that we can perceive the stars at such a distance. What an admirable transparency in these immense spaces to permit the light to pass, without being wasted, to thousands of billions of miles! Around us, in the thick air which envelops us, the mountains are already darkened and difficult to see at seventy miles; the least fog hides from us objects on the horizon. What must be the tenuity, the rarefaction, the extreme transparency of the ethereal medium which fills the celestial spaces!—FLAMMARION *Popular Astronomy*, bk. vi, ch. 1, p. 553. (A.)

519. CLIMATE, ALTERNATIONS OF—*Change from Glacial Epoch to Tropical Period—Siberian Mammoths — Elephant, Lion, Tiger.*—It will naturally be asked whether some recent geological discoveries bringing evidence to light of a colder, or as it has been termed "glacial epoch," towards the close of the Tertiary period throughout the northern hemisphere, does not conflict with the theory, above alluded to, of a warmer temperature having prevailed in the eras of the Eocene, Miocene, and Pliocene formations. In answer to this inquiry, it may certainly be affirmed that an oscillation of climate has occurred in times immediately antecedent to the peopling of the earth by man; but proof of the intercalation of a less genial climate, at an era when nearly all the marine and terrestrial testacea had already become specifically the same as those now living, by no means rebuts the conclusion previously drawn, in favor of a warmer condition of the globe during the ages which elapsed while the tertiary strata were deposited. In some of the most superficial patches of sand, gravel, and loam, scattered very generally over Europe, and containing recent shells, the remains of extinct species of land quadrupeds have been found, especially in places where the alluvial matter appears to have been washed into small lakes, or into depressions in the plains bordering ancient rivers. Similar deposits have also been lodged in rents and caverns of rocks, where they may have been swept in by land floods, or introduced by engulfed rivers during changes in the physical geography of these countries. . . . Among the extinct mammalia thus entombed, we find species of the elephant, rhinoceros, hippopotamus, bear, hyena, lion, tiger, monkey (*Macacus*), and many others, consisting partly of genera now confined to warmer regions.—LYELL *Principles of Geology*, ch. 6, p. 75. (A., 1854.)

520. ——— ——— *Elephants Once Abundant in Siberia—Ivory in Northern Russia.*—The most recent discoveries made in 1843 by Mr. Middendorf, a distinguished Russian naturalist, and which he communicated to me in September, 1846, afford more precise information as to the climate of the Siberian lowlands, at the period when the extinct quadrupeds were entombed. One elephant was found on the Tas, between the Obi and Yenisei, near the arctic circle, about lat. 66° 30′ N., with some parts of the flesh in so perfect a state that the bulb of the eye is now preserved in the mu-

seum at Moscow. Another carcass, together with a young individual of the same species, was met with in the same year, 1843, in lat. 75° 15′ N., near the River Taimyr, with the flesh decayed. It was embedded in strata of clay and sand, with erratic blocks, at about 15 feet above the level of the sea. In the same deposit Mr. Middendorf observed the trunk of a larch tree *(Pinus larix)*, the same wood as that now carried down in abundance by the Taimyr to the Arctic Sea. There were also associated fossil shells of living northern species, and which are moreover characteristic of the drift or glacial deposits of Europe. Among these *Nucula pygmæa*, *Tellina calcarea*, *Mya truncata*, and *Saxicava rugosa* were conspicuous.

So fresh is the ivory throughout northern Russia that, according to Tilesius, thousands of fossil tusks have been collected and used in turning; yet others are still procured and sold in great plenty. He declares his belief that the bones still left in northern Russia must greatly exceed in number all the elephants now living on the globe.—LYELL *Principles of Geology*, ch. 6, p. 81. (A., 1854.)

521. CLIMATE, EFFECT OF, ON STRUGGLE FOR LIFE—The action of climate seems at first sight to be quite independent of the struggle for existence; but in so far as climate chiefly acts in reducing food, it brings on the most severe struggle between the individuals, whether of the same or of distinct species, which subsist on the same kind of food. Even when climate, for instance, extreme cold, acts directly, it will be the least vigorous individuals, or those which have got least food through the advancing winter, which will suffer the most.—DARWIN *Origin of Species*, ch. 1, p. 64. (Burt.)

522. CLIMATE, EFFECT OF, UPON MAN—In the climate of America, compared with that of England, there is an important difference. That of England is a moist, moderate island climate, while that of America is continental, with extremely dry west winds and great extremes of heat and cold in summer and winter. The elimination of heat is greater in America, and consequently greater production of warmth within the organism is necessary; the tissue change has to be more rapid. This is apparent in the entire being of the American. Désor describes him exactly when he says that the American's activity, his hurry, his rushing, is more a matter of instinct, more the result of natural impatience than of necessity, the cause that creates restlessness and haste in the Englishman. The latter runs from zeal for business, the American from an inner impulse.—OPPENHEIMER *Ueber den Einfluss des Klimas auf den Menschen*, p. 31. (Translated for *Scientific Side-Lights.*)

523. CLIMATE EFFECTS CHANGES OF CHARACTERISTICS—*Wool Replaced by Hair—Hairless Cattle—Whiteness of Arctic Animals.*—I have myself seen in Southdown sheep, which had been transported only two years previously to the West Indies, the thick covering of wool replaced by short crisp hair, scarcely distinguishable from that of the goats which had inhabited the island for several generations; and the hottest parts of the South American pampas are inhabited by breeds of cattle (the descendants of those introduced by the Spaniards), of which some are nearly, and others quite, destitute of hair, and which cannot live in the more temperate air of the slopes of the Andes. It seems clear, then, that this adaptation results from some direct physical action of temperature on the constitution of the animals; and yet (like the expansion of water in cooling from 39.2° to 32°) it is in direct opposition to a very general law. The same may be said of the winter whitening of the fur and plumage of arctic mammals and birds. For, altho this (like the preceding) has been adduced as an example of "natural selection"—the white varieties surviving because they escape being seen upon ground whitened by snow—yet there must have been some cause for the production of the white varieties.—CARPENTER *Nature and Man*, lect. 15, p. 441. (A., 1889.)

524. CLOTHING OF BARK AND LEAVES—*Reversion to Primitive Customs.*—To come now to clothing proper. The man who wants a garment gets it in the simplest way when he takes the covering off a tree or a beast, and puts it on himself. The bark of trees provides clothes for rude races in many districts, as for instance in the curious use which natives of the Brazilian forests have long made of the so-called "shirt-tree" *(Lecythis)*. A man cuts a four- or five-feet length of the trunk, or a large branch, and gets the bark off in an entire tube, which he has then only to soak and beat soft and to cut slits for armholes, to be able to slip it on as a ready-made shirt; or a short length will make a woman's skirt. The wearing of bark has sometimes been kept up as a sign of primitive simplicity. Thus in India it is written in the laws of Manu that when the gray-haired Brahman retires into the forest to end his days in religious meditation, he shall wear a skin or a garment of bark. A ruder people, the Kayans of Borneo, while in common life they like the smart foreign stuffs of the trader, when they go into mourning throw them off and return to the rude native garment of bark-cloth. In Polynesia the manufacture of tapa from the bark of the paper-mulberry was carried to great perfection, the women beating it out with grooved clubs into a sort of vegetable felt, and ornamenting it with colored patterns stamped on. The people were delighted with the white paper of the Europeans, and dressed themselves in it as a fine

variety of tapa, till they found that the first shower of rain spoiled it. Leaves, also, are made into aprons or skirts which clothe various rude tribes. Not only are there "leaf-wearers" in India, but at a yearly festival in Madras the whole low-caste population cast off their ordinary clothing and put on aprons of leafy twigs.—TYLOR *Anthropology*, ch. 10, p. 244. (A., 1899.)

525. CLOUD-CAPITALS OF VIEWLESS COLUMNS—*Cumulous Clouds.*—Similar remarks apply to the formation of cumuli in our own latitudes; they are the heads of vaporous columns which rise from the earth's surface, and are precipitated as soon as they reach a certain elevation. Thus, the visible cloud forms the capital of an invisible pillar of saturated air. The top of such a column, raised above the lower vapor-screen which clasps the earth, and offering itself to space, is chilled by radiation and precipitated as cloud. Mountains act as condensers, partly by the coldness of their own masses, which they owe to their elevation. Above them spreads no vapor-screen of sufficient density to intercept their heat, which consequently passes unrequited into space. When the sun is withdrawn, this loss is shown by the quick descent of the thermometer.—TYNDALL *Heat a Mode of Motion*, lect. 13, p. 384. (A., 1900.)

526. CLOUD, INCIPIENT—*Rivals Azure of Italian Sky.*—It is possible, by duly regulating the quantity of vapor, to make our precipitated particles grow from an infinitesimal, and altogether ultra-microscopic size, to specks of sensible magnitude; and by means of these particles, in a certain stage of their growth, we can produce a blue which shall rival, if it does not transcend, that of the deepest and purest Italian sky. Let this point be in the first place established. Associated with our experimental tube is a barometer, the mercurial column of which now indicates that the tube is exhausted. Into the tube I introduce a quantity of the mixed air and nitrite of butyl vapor, sufficient to depress the mercurial column one-twentieth of an inch; that is to say, the air and vapor together exert a pressure of one-six-hundredth of an atmosphere. I now add a quantity of air and hydrochloric acid, sufficient to depress the mercury half an inch further, and into this compound and highly attenuated atmosphere I discharge the beam of the electric light. The effect is slow; but gradually within the tube arises a splendid azure, which strengthens for a time, reaches a maximum of depth and purity, and then, as the particles grow larger, passes into whitish blue. This experiment is representative, and it illustrates a general principle. Other colorless substances of the most diverse properties, optical and chemical, might be employed for this experiment. The incipient cloud, in every case, would exhibit this superb blue; thus proving to demonstration that particles of infinitesimal size, without any color of their own, and irrespective of the optical properties exhibited by the substances in a massive state, are competent to produce the color of the sky.—TYNDALL *Heat a Mode of Motion*, lect. 16, p. 484. (A., 1900.)

527. CLOUDS WITH LINING OF BLUE AND GOLD—*Beauty of Sunrise and Sunset on Worlds Lit by Colored Suns.*—The skies, however, must be often exceedingly beautiful. Our clouds have their silver lining, because it is the white light of the sun which illumines them. Our summer sky presents glowing white clouds to our view, and at other times we see the various shades between perfect whiteness and an almost black hue, corresponding to the various degrees in which the illuminated side of a cloud is turned towards us. But imagine how beautiful the scene must be, when those parts of a cloud which would otherwise appear simply darker, shine with a fuller blue light or (as the case may be) with a fuller orange light. How gorgeous again must be the coloring of the clouds which fleck the sky when one or other sun is setting! At such times on our earth we see the most beautiful tints, owing to the various degrees in which the atmosphere affects the light of our single sun; but how wonderful must be the varieties of color when, in addition to this cause of varying tints, there is a sun of complementary color illuminating those parts of each cloud which would be simply dark were there no other sun but the orb which is actually setting!—PROCTOR *Expanse of Heaven*, pp. 235-236. (L. G. & Co., 1897.)

528. COAL-DEPOSITS PROVE MILDER CLIMATE—*Tree-ferns Now Only Tropical.*—But it is from the more ancient coal-deposits that the most extraordinary evidence has been supplied in proof of the former existence of a very different climate—a climate which seems to have been moist, warm, and extremely uniform—in those very latitudes which are now the colder, and, in regard to temperature, the most variable, regions of the globe. We learn from the researches of Adolphe Brongniart, Goeppert, and other botanists, that in the flora of the Carboniferous era there was a great predominance of ferns, some of which were arborescent. . . . This prevalence of ferns indicates a moist, equable, and temperate climate, and the absence of any severe cold, for such are the conditions which, at the present day, are found to be most favorable to that tribe of plants. It is only in the islands of the tropical oceans, and of the southern temperate zone, such as Norfolk Island, Otaheite, the Sandwich Islands, Tristan d'Acunha, and New Zealand, that we find any near approach to that remarkable preponderance of ferns which is characteristic of the Carboniferous flora. It has been observed that tree-ferns and other forms of vegetation which flourished most luxuriantly within the tropics extend to a much

greater distance from the equator in the southern hemisphere than in the northern, being found even as far as 46° S. latitude in New Zealand. There is little doubt that this is owing to the more uniform and moist climate occasioned by the greater proportional area of sea.—LYELL *Principles of Geology*, ch. 6, p. 87. (A., 1854.)

529. CODE OF HONOR—*Permissions of Moral Evil.*—What may be called "club opinion" is one of the very strongest forces in life. The thief must not steal from other thieves; the gambler must pay his gambling debts, tho he pay no other debts in the world. The code of honor of fashionable society has throughout history been full of permissions as well as of vetoes, the only reason for following either of which is that so we best serve one of our social selves. You must not lie in general, but you may lie as much as you please if asked about your relations with a lady; you must accept a challenge from an equal, but if challenged by an inferior you may laugh him to scorn: these are examples of what is meant. —JAMES *Psychology*, vol. i, ch. 10, p. 295. (H. H. & Co., 1899.)

530. COINCIDENCE OF GREAT DISCOVERIES—*Columbus and Copernicus.*—The age of Columbus, Gama, and Magellan—the age of great maritime enterprises—coincided in a most wonderful manner with many great events, with the awakening of a feeling of religious freedom, with the development of nobler sentiments for art, and with the diffusion of the Copernican views regarding the system of the universe. Nicolaus Copernicus had already attained his twenty-first year, and was engaged in making observations with the astronomer Albert Brudzewski, at Cracow, when Columbus discovered America. Hardly a year after the death of the great discoverer, and after a six years' residence at Padua, Bologna, and Rome, we find him returned to Cracow, and busily engaged in bringing about a thorough revolution in the astronomical views of the universe. . . . He was nominated, in 1510, canon of Frauenburg, where he labored for thirty-three years on the completion of his work, entitled "De Revolutionibus Orbium Cœlestium." The first printed copy was brought to him when, shattered in mind and body, he was preparing himself for death. He saw it and touched it, but his thoughts were no longer fixed on earthly things, and he died several days afterward (on the 24th of May, 1543).—HUMBOLDT *Cosmos*, vol. ii, pt. ii, p. 303. (H., 1897.)

531. ——— ——— *Moons of Jupiter Simultaneously Discovered.*—The moons of Jupiter, the first of all the secondary planets discovered by the telescope, were first seen, almost simultaneously and wholly independently, on the 29th of December, 1609, by Simon Marius at Ansbach, and on the 7th of January, 1610, by Galileo at Padua. In the publication of this discovery, Galileo, by the "Nuncius Siderius" (1610), preceded the "Mundus Jovialis" (1614) of Simon Marius. . . .

The discovery of Jupiter's satellites marks an ever memorable epoch in the history and the vicissitudes of astronomy. The occultations of the satellites, or their entrance into Jupiter's shadow, led to a knowledge of the velocity of light (1675), and, through this knowledge, to the explanation of the *aberration-ellipse* of the fixed stars (1727), in which the great orbit of the earth, in its annual course round the sun, is, as it were, reflected on the vault of heaven. These discoveries of Römer and Bradley have been justly termed "the keystone of the Copernican system," the perceptible evidence of the translatory motion of the earth.—HUMBOLDT *Cosmos*, vol. ii, pt. ii, pp. 320, 322. (H., 1897.)

532. COLOR, ABSENCE OF, HELPFUL AT A CERTAIN STAGE—*Advantages of the Glass Animals in the Struggle for Existence.*—Evidently for all glass animals, carrying on their unceasing warfare, their waterlike bodily composition is of the greatest utility. The pursuers can approach their prey without being observed, the pursued are able more easily to escape than if both were colored and wanting in transparency, and therefore more readily visible in clear water. Suppose we assume that of these glass animals different varieties existed originally, varying especially in the degree of transparency and want of color. Then, certainly, those individuals that were most transparent and colorless would achieve the preponderance in the struggle for existence, at the same time confirming and strengthening those advantageous individual peculiarities for generations, and finally arrive at a perfectly glasslike development.—HAECKEL *Generelle Morphologie*, vol. ii, p. 243. (Translated for *Scientific Side-Lights.*)

533. COLOR A NEGATIVE QUALITY—*Produced by Subtraction, Not by Addition.*—Pass a black ribbon through the colors of the spectrum; it quenches all of them. The meaning of blackness is thus revealed—it is the result of the absorption of all the constituents of solar light. Pass a red ribbon through the spectrum. In the red light the ribbon is a vivid red. Why? Because the light that enters the ribbon is not quenched or absorbed, but in great part sent back to the eye. Place the same ribbon in the green of the spectrum; it is black as jet. It absorbs the green light, and leaves the space on which it falls a space of intense darkness. Place a green ribbon in the green of the spectrum. It shines vividly with its proper color; transfer it to the red, it is black as jet. Here it absorbs all the light that falls upon it, and offers mere darkness to the eye. Thus, when white light is employed, the red sifts it by quenching the

green, and the green sifts it by quenching the red, both exhibiting the residual color. The process through which natural bodies acquire their colors is therefore a negative one. The colors are produced by subtraction, not by addition. This red glass is red because it destroys all the more refrangible rays of the spectrum. This blue liquid is blue because it destroys all the less refrangible rays. Both together are opaque because the light transmitted by the one is quenched by the other. In this way, by the union of two transparent substances we obtain a combination as dark as pitch to solar light. This other liquid, finally, is purple because it destroys the green and the yellow, and allows the terminal colors of the spectrum to pass unimpeded. From the blending of the blue and the red this gorgeous purple is produced.—TYNDALL *Lectures on Light*, lect. 1, p. 32. (A., 1898.)

534. COLOR A PROTECTION—*Bird Feeding on Ground—Tree-trunk a Hiding-place.*—The Sclerurus, altho an inhabitant of the darkest forest, and provided with sharply curved claws, never seeks its food on trees, but exclusively on the ground, among the decaying fallen leaves; but, strangely enough, when alarmed it flies to the trunk of the nearest tree, to which it clings in a vertical position, and, remaining silent and motionless, escapes observation by means of its dark protective color.—HUDSON *Naturalist in La Plata*, ch. 18, p. 240. (C. & H., 1895.)

535. COLOR AS PROTECTIVE FROM HEAT—*White for Military Uniforms.*—By instinct, or perhaps as the result of the experience of centuries, the native Algerians have adopted white as the color for their clothing. Evidently they never dream of manufacturing uniforms of colored woolen cloth. It would be possible to shade soldiers on a march, or other expedition, from the sun's rays, with the aid of a simple cotton burnoose at only a slightly increased cost, and whose volume would be very little. This is an experiment worth trying, at least on a small scale; the use of this vestment would have as an immediate result the placing of the soldier within a medium cooler by ten or a dozen degrees, and all physicians who have accompanied troops on a march are aware that a number of degrees more or less for a man that is fatigued, or has an attack of fever, or is wounded, is a question of life or death. In any case, it would always be well to place some of these white vestures at the disposal of the physician for the use of sick men menaced or attacked by congestion during a march.—COULIER *Expériences sur les Étoffes qui servent à confectionner les Vêtements Militaires*, p. 138, *Journal de la Physiologie de l'Homme et des Animaux.* (Translated for *Scientific Side-Lights.*)

536. COLOR, DEPENDENCE OF, ON OBSERVER—*Color-blindness—The World in Chiaroscuro.*—It is agreed alike by physicists and physiologists that color does not exist as such in the object itself, which has merely the power of reflecting or transmitting a certain number of millions of undulations in a second, and these only produce that affection of our consciousness which we call color, when they fall upon the retina of the living percipient. And if there be that defect either in the retina or in the apparatus behind it, which we call "color-blindness" or Daltonism, some particular hues cannot be distinguished, or there may even be no power of distinguishing any color whatever. If we were all like Dalton, we should see no difference, except in form, between ripe cherries hanging on a tree and the green leaves around them; if we were all affected with the severest form of color-blindness, the fair face of Nature would be seen by us as in the chiaroscuro of an engraving of one of Turner's landscapes, not as in the glowing hues of the wondrous picture itself.—CARPENTER *Nature and Man*, p. 201. (A., 1889.)

537. COLOR IN FLOWERS AND FRUITS—*Beauty Subserves a Purpose.*—Between fruits and flowers, in the matter of color, there is a close and intimate association. Every schoolboy who is taught botany knows that flowers are colored to attract insects, while the insects in turn cross-fertilize the plants by carrying the pollen-dust from one flower to another flower of the same species. Color in flowers, then, has a purpose all undreamt of by the older botanists. What of fruits? Color here, in the logical sequence of events, must be credited with a purpose also. Let us see what that design may be. When you look at an apple or orange you are struck by the apparently big size of the edible part of the fruit, and by the relatively small size of the seeds. Compared with, say, the fruits of a buttercup, represented by the collection of little dry green bodies borne on the end of the flower-stalk, the apple, orange, peach, plum, and cherry are grandiose in the extreme. The apple-substance does not nourish the seed. There is no question of nutrition involved in the matter at all. The seeds are all ready to produce the new plants, and lie concealed within the apple, and cherry or plum stone, waiting their season and opportunity. Why, then, all this big growth of eatable material? The answer is, "For the birds and insects, and for any other animal agencies which will help the plant on its way of life." The blackbirds that peck at the peaches and apples are Nature's servitors. They come for their food to the gardener's preserves, and as they split up the dainty succulent fruit, they liberate [and scatter] the seeds, and thus secure the prospect of

fresh generations of plants.—ANDREW WILSON *Glimpses of Nature,* ch. 22. p. 72. (Hum., 1892.)

538. COLOR OF PIGMENTS—*Absorption and Reflection Unite to Determine—The Rose Seen by Light Reflected Back through Its Substance—Exhaustion by Waste of Echoes.*—Pigments are composed of particles mixed with a vehicle: but how intimately soever the particles may be blended, they still remain particles, separated it may be by exceedingly minute distances, but still separated. To use the scientific phrase, they are not optically continuous. Now, wherever optical continuity is ruptured we have reflection of the incident light. It is the multitude of reflections at the limiting surfaces of the particles that prevents light from passing through glass, or rock salt, when these transparent substances are pounded into powder. The light here is exhausted in a waste of echoes, not extinguished by true absorption. It is the same kind of reflection that renders the thunder-cloud so impervious to light. Such a cloud is composed of particles of water mixed with particles of air, both separately transparent, but practically opaque when thus mixed together. In the case of pigments, then, the light is reflected at the limiting surfaces of the particles, but it is in part absorbed within the particles. The reflection is necessary to send the light back to the eye; the absorption is necessary to give the body its color. The same remarks apply to flowers. The rose is red in virtue, not of the light reflected from its surface, but of light which has entered its substance, which has been reflected from surfaces within, and which in returning through the substance has had its green extinguished. A similar process in the case of hard green leaves extinguishes the red, and sends green light from the body of the leaves to the eye. —TYNDALL *Lectures on Light,* lect. 1, p. 34. (A., 1898.)

539. COLOR OF THE SKY—*Hues of Flowers Due to Absorption—Fine Particles Make Blue of Sky—Alpine Sunrise and Sunset.*—First, then, with regard to the sky: how is it produced, and can we not reproduce it? Its color has not the same origin as that of ordinary coloring matter, in which certain portions of the white solar light are absorbed, the color of the body being that of the light which remains. A violet is blue because its molecular texture enables it to quench the yellow and red constituents of white light, and to send back the blue from its interior. A geranium is red because its molecular texture is such as quenches all rays except the red. Such colors are called colors of absorption; but the hue of the sky is not of this character. The blue light of the sky is scattered light; and, were there nothing in our atmosphere competent to scatter the solar rays, we should see no blue firmament, but the mere darkness of infinite space. The blue of the sky is produced by perfectly colorless particles. Smallness of size alone is requisite to insure the selection and reflection of this color. Of all the visual waves emitted by the sun, the shortest and smallest are those corresponding to the color blue. To such small waves minute particles offer more obstruction than to large ones, hence the predominance of blue color in all light reflected from such particles. The crimson glow of the evening and the morning, seen so finely in the Alps, is due, on the other hand, to transmitted light; that is to say, to light which, in its passage through great atmospheric distances, has its blue constituents sifted out of it by repeated collision with suspended particles.—TYNDALL *Heat a Mode of Motion,* lect. 16, p. 484. (A., 1900.)

540. ——— ——— *May Be Produced Artificially—Light Liberates Atoms from Vapor.*—We can liberate, in air, particles of a size capable of producing a blue as deep and pure as the azure of the firmament. In fact, artificial skies may be thus generated, which prove their brotherhood with the natural sky by exhibiting all its phenomena. There are certain chemical compounds—aggregates of molecules—the constituent atoms of which are readily shaken asunder by the impact of special waves of light. Probably, if not certainly, the atoms and the waves are so related to each other, as regards vibrating period, that the wave-motion can accumulate until it becomes disruptive. A great number of substances might be mentioned whose vapors, when mixed with air and subjected to the action of a solar or an electric beam, are thus decomposed, the products of decomposition hanging as liquid or solid particles in the beam which generates them. . . . Like the natural sky, the artificial one shows all the colors of the spectrum, but blue in excess.—TYNDALL *Fragments of Science,* vol. i, ch. 5, p. 137. (A., 1897.)

541. COLORATION, PROTECTIVE, UNIVERSAL—*Natural Objects of Every Kind Imitated by Living Beings.*—Protective coloration, in some of its varied forms, has not improbably modified the appearance of one-half of the animals living on the globe. The white of arctic animals, the yellowish tints of the desert forms, the dusky hues of crepuscular and nocturnal species, the transparent or bluish tints of oceanic creatures, represent a vast host in themselves; but we have an equally numerous body whose tints are adapted to tropical foliage, to the bark of trees, or to the soil or dead leaves on or among which they habitually live. Then we have the innumerable special adaptations to the tints and forms of leaves, or twigs, or flowers; to bark or moss; to rock or pebble; by which such vast numbers of the insect tribes obtain protection: and these various forms of coloration are equally prevalent in

the waters of the seas and oceans, and are thus coextensive with the domain of life upon the earth.—WALLACE *Darwinism*, ch. 8, p. 155. (Hum., 1889.)

542. COLOR-BLINDNESS—*More Common among Men than among Women—Defect Commonly Congenital.*—Color-blindness is found much more common among men than women. Out of one hundred and fifty registered cases, there are but six of females, and one of these is doubtful. It has been conjectured that needlework on a variety of colored articles might be the means of counteracting the tendency to this defect, as well as to produce a delicacy of discrimination of different shades of color not possessed by those otherwise employed. But in answer to this it has been remarked, that in the case of "Daltonians" engaged in painting there has been found but little, if any, improvement of the condition of vision; and the very employment of the females on works which require a constant comparison of color would daily reveal cases of blindness of this kind did it frequently exist in the female sex. This peculiarity of vision is principally congenital. Professor Wartmann has found but two exceptions. In one of these, colors were perceived in the usual manner until at the ninth year, when the boy received a violent blow on the head, which fractured the skull, and rendered a surgical operation necessary. The fact, however, that three of the brothers of this individual were affected with the same kind of vision renders it probable that he was constitutionally predisposed to this peculiarity. —HENRY *Scientific Works*, vol. i, p. 238. (Sm. Inst., 1886.)

543. COLORS IN DEEP-SEA FISH—*Dark or Dull Hues Prevail.*—The majority of the fish are dark brown or black, but many other colors are represented. . . . Many examples could be given to show the prevalence in these regions of these black, dull, and pale uniform colors. But there are many exceptional cases.—HICKSON *Fauna of the Deep Sea*, ch. 4, p. 59. (A., 1894.)

544. COLORS OBTAINED FROM THIN FILMS—*Due to Interference of Light-waves.*—He [Robert Hooke] then describes fully and clearly the experiment with pressed glasses: "Take two small pieces of ground and polished looking glass plate, each about the bigness of a shilling; take these two dry, and with your forefingers and thumbs press them very hard and close together, and you shall find that when they approach each other very near there will appear several irises or colored lines, . . . and you may very easily change any of the colors of any part of the interposed body by pressing the plates closer and harder together, or leaving them more lax—that is, a part which appeared colored with a red may be presently tinged with a yellow, blue, green, purple, or the like. Any substance," he says, "provided it be thin and transparent, will show these colors." Like Boyle, he obtained them with glass films; he also "produced them with bubbles of pitch, rosin, colophony, turpentine, solutions of several gums, as gum arabic in water, any glutinous liquor, as wort, wine, spirit of wine, oil of turpentine, glare of snails, etc." [See COLORS OF THIN PLATES, 548-9.]—TYNDALL *Lectures on Light*, lect. 2, p. 70. (A., 1898.)

545. COLORS OF SPECTRUM—*Aristotle's Theory of Combination of Black and White—Experiment Disposes of Ancient Error.*—Aristotle taught that black and white are the two fundamental qualities of light, and that every color can be obtained from their intermixture in varying amounts. . . . The Aristotelian view of the origin of color prevailed until modern times. Goethe defended it, and many of his admirers are its enthusiastic champions. But it has been banished from science these two hundred years, thanks to Newton's discoveries. Newton said to himself: If there really are simple kinds of light or simple colors, which intermix in various ways, we must be able both to isolate and to recombine the simple constituents of any given compound color. That meant that the whole question was referred to the tribunal of experiment, where alone it could be definitely answered. For direct perception is deceptive. Can the chemist "see" of what elements a body is composed? Of course not. We know that bodies of very different chemical composition appear just alike. May not the same hold of light? May not similar kinds of light give rise to different mixtures, and different kinds to similar mixtures? So Newton looked round him for a means of analyzing compound light, and by a happy accident found what he wanted in the refraction of light by the prism.—WUNDT *Psychology*, lect. 6, p. 88. (Son. & Co., 1896.)

546. COLORS OF STARS—*Change of Color of Sirius.*—The Greek astronomers were acquainted with red stars only, while modern science has discovered, by the aid of the telescope, in the radiant fields of the starry heaven, as in the blossoms of the phanerogamia, and in the metallic oxids, almost all the gradations of the prismatic spectrum between the extremes of refrangibility of the red and the violet ray. Ptolemy enumerates in his catalog of the fixed stars six (ὑποκίρροι) fiery red stars—viz., Arcturus, Aldebaran, Pollux, Antares, α Orionis (in the right shoulder), and Sirius. Cleomedes even compares Antares in Scorpio with the fiery red Mars, which is called both πυῤῥός and πυροειδής. Of the six above-named stars, five still retain a red or reddish light. Pollux is still indicated as a reddish but Castor as a greenish star. Sirius therefore affords the only example of

an historically proved change of color, for it has at present a perfectly white light. A great physical revolution must therefore have occurred at the surface or in the photosphere of this fixed star.—HUMBOLDT *Cosmos*, vol. iii, p. 130. (H., 1897.)

547. ——— ——— *Variety and Contrast of—Instances of Double, Triple, and Multiple Stars.* — Stars have also been noticed which, instead of showing a white or golden light, as is generally the case, are colored with the most vivid tints, such as those of the emerald, sapphire, ruby, topaz, garnet, and the finest of our precious stones. The telescope has discovered a large number which, instead of being single, as they appear to the naked eye, are double, composed of two stars close together which turn round each other in revolutions which we have already been able to calculate, and which include the most varied periods, from a few years to several centuries and even thousands of years. Sometimes the system is triple: a bright star is seen accompanied by two little companions, and while these two revolve round each other, they move together and revolve round the large one. It is among these multiple systems that we find the most wonderful contrasts of colors. The science is already so far advanced in this respect that I have been able to form a catalog of nearly 1,000 double stars in certain motion, and to construct a chart of more than 10,000 double stars which have been discovered.—FLAMMARION *Popular Astronomy*, bk. vi, ch. 3, p. 580. (A.)

548. COLORS OF THIN PLATES— *Films of Any Kind Illustrate—Newton Blowing Soap-bubbles.*—This subject [of the interference of light-waves] may be illustrated by the class of phenomena which first suggested the undulatory theory to the mind of Hooke. These are the colors of thin transparent films of all kinds, known as the colors of thin plates. In this relation no object in the world possesses a deeper scientific interest than a common soap-bubble. And here let me say emerges one of the difficulties which the student of pure science encounters in the presence of "practical" communities like those of America and England; it is not to be expected that such communities can entertain any profound sympathy with labors which seem so far removed from the domain of practise as many of the labors of the man of science are. Imagine Dr. Draper spending his days in blowing soap-bubbles and in studying their colors! Would you show him the necessary patience, or grant him the necessary support? And yet, be it remembered, it was thus that minds like those of Boyle, Newton, and Hooke were occupied; and that on such experiments has been founded a theory the issues of which are incalculable. I see no other way for you, laymen, than to trust the scientific man with the choice of his inquiries; he stands before the tribunal of his peers, and by their verdict on his labors you ought to abide.—TYNDALL *Lectures on Light*, lect. 2, p. 65. (A., 1898.)

549. ——— ——— *Interference of Light-waves Illustrated—Prismatic Colors of a Film of Spirit of Turpentine on Water.*—Take with you a little bottle of spirit of turpentine, and pour it into one of your country ponds. You will then see the flashing of those colors over the surface of the water. On a small scale we produce them thus: A common tea-tray is filled with water, beneath the surface of which dips the end of a pipette. A beam of light falls upon the water, and is reflected by it to the screen. Spirit of turpentine is poured into the pipette; it descends, issues from the end in minute drops, which rise in succession to the surface. On reaching it, each drop spreads suddenly out as a film, and glowing colors immediately flash forth upon the screen. The colors change as the thickness of the film changes by evaporation. They are also arranged in zones, in consequence of the gradual diminution of thickness from the center outwards. [See COLORS OBTAINED FROM THIN FILMS; LIGHT, DOUBLE REFLECTION OF, PLATES; etc.]—TYNDALL *Lectures on Light*, lect. 2, p. 67. (A., 1898.)

550. COLORS RESULTING FROM MOLECULAR ARRANGEMENT OF SUBSTANCES—It is the molecular arrangement of reflecting or transparent substances which gives rise to the different reflections of light—that is to say, the colors. A slight difference produces here a blue eye, pensive and thoughtful, there a brown eye with half-hidden flames, there a look dull and distasteful. The dazzling rose which blooms in the flower-garden receives the same light as the lily, the buttercup, the cornflower, or the violet; molecular reflection produces all the difference; and we might even say, without metaphor, that objects are of all colors except that which they appear. Why is the meadow green? Because it keeps all except the green, which it does not want, and sends back. White is formed by the reflective nature of an object which keeps nothing and returns all: black, by a surface which keeps all and sends back nothing.—FLAMMARION *Popular Astronomy*, bk. iii, ch. 7, p. 321. (A.)

551. COMBINATION MAY PERISH— *Substance or Agent Must Remain.*—There is no existing order—no present combination of matter or of force—which we cannot conceive coming to an end. But when that end is come, we cannot conceive but that something must remain—if it be nothing else than that by which the ending was brought about.—ARGYLL *Unity of Nature*, ch. 4, p. 85. (Burt.)

552. COMBINATION OF INTELLIGENCE— *The Republic of the Stars—By Electricity the Astronomer Looks from All Parts of the World at Once.*—Modern facilities of communication have helped to impress more

deeply upon modern astronomy its associative character. The electric telegraph gives a certain ubiquity which is invaluable to an observer of the skies. With the help of a wire, a battery, and a code of signals, he sees whatever is visible from any portion of our globe, depending, however, upon other eyes than his own, and so entering as a unit into a wide-spread combination of intelligence. The press, again, has been a potent agent of cooperation. I has mainly contributed to unite astronomers all over the world into a body animated by the single aim of collecting "particulars" in their special branch for what Bacon termed a History of Nature, eventually to be interpreted according to the sagacious insight of some one among them gifted above his fellows.—CLERKE *History of Astronomy*, int., p. 7. (Bl., 1893.)

553. COMBINATION OF THE SEEMINGLY INCOMPATIBLE — *Fossils Ejected from Depths of Volcano.*—At Vesuvius fragments of limestone are frequently ejected, and may be picked up all over the slopes of the mountains. These limestone-fragments frequently contain fossils, and Professor Guiscardi, of Naples, has been able to collect several hundred species of shells, transported thus by volcanic action from the rock-masses which form the foundation of the volcano of Vesuvius. The action of water at a high temperature, and under such enormous pressure as must exist beneath volcanic mountains, has often produced changes in the rocks of which fragments are ejected from volcanic vents.—JUDD *Volcanoes*, ch. 3, p. 45. (A., 1899.)

554. COMBINATIONS, HUMAN, MUST ACT WITH NATURE—Combination is natural to man. The desire for it and the need of it grow with the growth of knowledge and with the increasing complications of society. It has now, for the most part, emerged from the stage of rude ignorance which led to the breaking of machinery. It is conducted, comparatively at least, with high intelligence, and aims for the most part at legitimate objects of desire. Yet in the rebellion which has been roused against the doctrines of necessity, founded on false conceptions of invariable law, there is a constant danger lest the spirit of association should attempt to act against Nature, instead of acting with it.—ARGYLL *Reign of Law*, ch. 7, p. 224. (Burt.)

555. COMBUSTION, ITS CHIEF PRODUCTS INVISIBLE—The chief products of ordinary combustion—that is, the compounds of oxygen with the elements of coal, wood, and illuminating gas—are only two in number, carbonic dioxid gas and aqueous vapor. These products, as is well known, are perfectly colorless and transparent aeriform substances, wholly without odor or taste, and entirely devoid of every active quality. For this reason they escape without observation from the burning wood, ascend our chimneys, and by the force of diffusion are spread throughout the atmosphere; but if, as may readily be done by chemical means, we collect the neglected smoke and weigh it, we shall find that it weighs much more than the burnt wood, and, as more careful experiments will show, its weight is exactly equal to that of the wood added to that of the oxygen of the air consumed during the burning.—COOKE *Religion and Chemistry*, ch. 3, p. 78. (A., 1897.)

556. COMETS ARE MOVING ELECTRIC LIGHTS—The gaseous surroundings of comets are then largely made up of a compound of hydrogen with carbon. Other materials are also present; but the hydrocarbon element is probably unfailing and predominant. Its luminosity is, there is little doubt, an effect of electrical excitement. Zöllner showed in 1872 that, owing to evaporation and other changes produced by rapid approach to the sun, electrical processes of considerable intensity must take place in comets; and that their original light is immediately connected with these, and depends upon solar radiation, rather through its direct or indirect electrifying effects than through its more obvious thermal power may be considered a truth permanently acquired to science. They are not, it thus seems, bodies incandescent through heat, but glowing by electricity; and this is compatible, under certain circumstances, with a relatively low temperature.—CLERKE *History of Astronomy*, pt. ii, ch. 10, p. 416. (Bl., 1893.)

557. COMMUNICATION, ELECTRICAL—*Vision of a Possible Future.*—In a lecture on Submarine Telegraphy at the Imperial Institute (February 15, 1897), Professor Ayrton said: "I have told you about the past and about the present. What about the future? Well, there is no doubt the day will come, maybe when you and I are forgotten, when copper wires, gutta-percha coverings, and iron sheathings will be relegated to the museum of antiquities. Then, when a person wants to telegraph to a friend, he knows not where, he will call in an electro-magnetic voice, which will be heard loud by him who has the electro-magnetic ear, but will be silent to every one else. He will call, 'Where are you?' and the reply will come, 'I am at the bottom of the coal-mine,' or 'Crossing the Andes,' or 'In the middle of the Pacific'; or perhaps no reply will come at all, and he may then conclude the friend is dead."—FAHIE *Wireless Telegraphy*, pref., p. 7. (D. M. & Co., 1900.)

558. COMMUNION OF PRIMITIVE MAN WITH NATURE—*Astronomy the Most Ancient of the Sciences—The Moon's Phases the Origin of the Calendar—"He Appointed the Moon for Seasons" (Ps. civ. 19).*—Our forefathers lived in more intimate com-

munication with Nature than we do. They had neither the artificial life, nor the hypocrisy, nor the anxieties created by the factitious necessities of modern existence. It was they who established the first bases of the sciences by the direct observation of natural phenomena. If astronomy is the most ancient of the sciences, the study of the moon was the most ancient of astronomical observations, because it was the simplest, the easiest, and the most useful. The solitary globe of night pours out its calm and clear light in the midst of the silence and contemplation of Nature. The succession of its phases provided shepherds as well as travelers with the first measure of time, after that of day and night, due to the diurnal rotation of our planet. The lunar crescent, with its melancholy light, gave to Nature a pastoral calendar.—FLAMMARION *Popular Astronomy*, bk. ii, ch. 2, p. 96. (A.)

559. COMMUNITY OF NEED AND SUPPLY—*Chopping-knife in Use among Eskimo Women.*—The Eskimo women have a knife precisely like the mincing-choppers in every kitchen, which they use at present for all sorts of work. But is it not interesting to find dainty little women almost at the jumping-off place of the globe holding on to the primeval form of an implement as well as its use whose modern representative does service both in our kitchens and our saddler-shops? The saddler and his wife now divide between them an implement which many thousands of years ago would have been hers alone, and he would have been defiled to touch it. With it, in that early day, she made harness for dogs and for herself to wear, besides cutting out clothing and tents, skinning animals, and mincing food.—MASON *Woman's Share in Primitive Culture*, ch. 2, p. 27. (A., 1894.)

560. COMPARISON OF DIFFERENT VIEWS—*Celestial Objects Located by Combining Observations—Transit of Venus—The Planet a Celestial Index.*—To determine the distance of an inaccessible object we must compare the direction in which it lies as seen from two stations sufficiently far apart. This, which is a principle of ordinary land-surveying, is equally true of the celestial objects. The astronomer determines the moon's distance by observing her from the northern and southern hemispheres, as from the Greenwich Observatory and the observatory at Cape Town; or else he takes advantage of the fact that the earth rotates on her axis, and so carries any given station from one side to another in a given time. The distance of the sun can be measured in no other (direct) way, and altho we hear of the transits of Venus as means of which the astronomer avails himself to determine the sun's distance, yet the very same principle is involved—the value of a transit of Venus depending solely on the fact that the observers at two distant stations can in point of fact regard her as a celestial index, traversing the sun's face as an index-plate, so that they possess, as it were, an instrument of survey more powerful than any terrestrial instrument.—PROCTOR *Expanse of Heaven*, p. 241. (L. G. & Co., 1897.)

561. COMPENSATION IN CHRONOMETER—*Self-adjustment to Heat or Cold—Cause Back of Mechanism.*—We find a singularly parallel case in that beautiful piece of human workmanship—a clock or chronometer so constructed as, by the accurate "compensation" of its pendulum or balance-wheel, to keep accurate time under all ordinary variations of climatic temperature. Surely we do not consider it a sufficient account of its self-adjustment to attribute it to the physical action of heat or cold: for this would disturb the performance of an ordinary clock or watch. We seek the explanation of its special "potentiality" in the compensating apparatus; and we trace back the origin of this apparatus to the mind of its contriver. So, as it seems to me, however long may be the chain of "causation," or the series of "unconditional sequences," that may be traceable backwards in the ancestral history of any organized type, we come to a beginning of it, as to the first term of an arithmetical or geometrical progression; and we have no less to account for the common beginning of the whole organized creation, with its unlimited possibilities of modification and adaptation, than if we had to account for the separate production of each type of plant and animal.—CARPENTER *Nature and Man*, lect. 15, p. 442. (A., 1889.)

562. COMPENSATION IN NATURE—*Insectivorous Plants Flourish in Poor Soil—Interchange of Functions of Organs—Roots Defective when Leaves Supply Food.*—The absorption of animal matter from captured insects explains how Drosera can flourish in extremely poor peaty soil. . . . Altho the leaves at a hasty glance do not appear green, owing to the purple color of the tentacles, yet the upper and lower surfaces of the blade, the pedicels of the central tentacles, and the petioles contain chlorophyl, so that, no doubt, the plant obtains and assimilates carbonic acid from the air. Nevertheless, considering the nature of the soil where it grows, the supply of nitrogen would be extremely limited, or quite deficient, unless the plant had the power of obtaining this important element from captured insects. We can thus understand how it is that the roots are so poorly developed. These usually consist of only two or three slightly divided branches, from half to one inch in length, furnished with absorbent hairs. It appears, therefore, that the roots serve only to imbibe water; tho, no doubt, they would absorb nutritive matter if present in the soil. . . . A plant of Drosera, with the edges of its leaves curled inwards, so as to form a temporary stomach, with the

glands of the closely inflected tentacles pouring forth their acid secretion, which dissolves animal matter, afterwards to be absorbed, may be said to feed like an animal. But, differently from an animal, it drinks by means of its roots; and it must drink largely, so as to retain many drops of viscid fluid round the glands, sometimes as many as 260, exposed during the whole day to a glaring sun.—DARWIN *Insectivorous Plants*, ch. 1, p. 14. (A., 1900.)

563. COMPENSATIONS OF THE DEEP—*Lack of Sight Accompanied by Superior Organs of Touch.*—The disappearance of the sense of sight in the animals of the deep sea is sometimes accompanied by an enormous development of tactile organs. Thus, among fishes we find *Bathypterois*, a form that possesses extremely small eyes, provided with enormously long pectoral fin-rays that most probably possess the functions of organs of touch. Among the Crustacea we find the blind form, *Galathodes Antonii*, with an extraordinary development in length of the antennæ, and *Nematocarcinus*, with enormously long antennæ and legs.—HICKSON *Fauna of the Deep Sea*, ch. 4, p. 75. (A., 1894.)

564. COMPETITORS, NEW, AFFECT PLANT OR ANIMAL IN NEW LAND—Hence we can see that when a plant or animal is placed in a new country, among new competitors, the conditions of its life will generally be changed in an essential manner, altho the climate may be exactly the same as in its former home. If its average numbers are to increase in its new home, we should have to modify it in a different way to what we should have had to do in its native country; for we should have to give it some advantage over a different set of competitors or enemies.—DARWIN *Origin of Species*, ch. 3, p. 72. (Burt.)

565. COMPLEXITY OF CONSCIOUSNESS ALWAYS—*No Feeling or Motive Simple and Unmingled.*—We have thus fields of consciousness—that is the first general fact; and the second general fact is that the concrete fields are always complex. They contain sensations of our bodies and of the objects around us, memories of past experiences and thoughts of distant things, feelings of satisfaction and dissatisfaction, desires and aversions, and other emotional conditions, together with determinations of the will, in every variety of permutation and combination.—JAMES *Talks to Teachers*, ch. 2, p. 17. (H. H. & Co., 1900.)

566. COMPLEXITY OF HUMAN BRAIN AND FINENESS OF STRUCTURE—*Adapted to Freedom and Variety of Human Thought.*—When it is remembered, indeed, that the brain itself is very large, the largest mass of nerve-matter in the organic world; when it is further realized that each of the cells of which it is built up measures only one-ten-thousandth of an inch in diameter, that the transit-fibers which connect them are of altogether unimaginable fineness, the limitlessness of the powers of thought and the inconceivable complexity of these processes will begin to be understood.—DRUMMOND *Ascent of Man*, p. 286. (J. P., 1900.)

567. COMPLEXITY OF THE STRUGGLE FOR LIFE—*Humblebees—Field-mice—Cats.*—Humblebees alone visit red clover, as other bees cannot reach the nectar. . . . Hence we may infer as highly probable that, if the whole genus of humblebees became extinct or very rare in England, the red clover would become very rare, or wholly disappear. The number of humblebees in any district depends in a great measure upon the number of field-mice, which destroy their combs and nests; and Colonel Newman, who has long attended to the habits of humblebees, believes that "more than two-thirds of them are thus destroyed all over England." Now the number of mice is largely dependent, as every one knows, on the number of cats. . . . Hence it is quite credible that the presence of a feline animal in large numbers in a district might determine, through the intervention first of mice and then of bees, the frequency of certain flowers in that district.—DARWIN *Origin of Species*, ch. 1, p. 68. (Burt.)

568. COMPLEXITY REQUIRES TIME FOR DEVELOPMENT—Two organisms of the same size, but belonging to different grades of organization, will require different periods of time for their development. Certain animals of a very lowly organization, such as the Rhizopoda, may attain a diameter of .5 mm. and may thus become larger than many insects' eggs. Yet under favorable circumstances an ameba can divide into two animals in ten minutes, while no insect's egg can develop into the young animal in a less period than twenty-four hours. Time is required for the development of the immense number of cells which must in the latter case arise from the single egg-cell.—WEISMANN *Heredity*, vol. i, ch. 1, p. 8. (Cl. P., 1891.)

569. COMPOSITION OF FORCES—*Path of a Pendulum Changed to an Ellipse.*—Suspended before you is a pendulum, which, when drawn aside and liberated, oscillates to and fro. If, when the pendulum is passing the middle point of its excursion, I impart a shock to it tending to drive it at right angles to its present course, what occurs? The two impulses compound themselves to a vibration oblique in direction to the former one, but the pendulum still oscillates in a plane. But, if the rectangular shock be imparted to the pendulum when it is at the limit of its swing, then the compounding of the two impulses causes the suspended ball to describe, not a straight line, but an ellipse; and, if the shock be competent of itself to produce a vibration of the

same amplitude as the first one, the ellipse becomes a circle.—TYNDALL *Lectures on Light*, lect. 4, p. 142. (A., 1898.)

570. COMPREHENSIVENESS OF GENIUS—*Newton Proved Gravitation by Studying the Disturbances of the Moon's Motion.*—It was in dealing with these disturbances [of the moon] that Newton showed with what wonderful mental powers he had been endowed. He tracked the moon through all her movements, and measured the sun's action on her in all positions; he showed where she would be hastened, where retarded, where drawn away from the earth, where drawn closer, where her path would be more tilted, where less, where its eccentricity would be increased, where diminished. All the peculiarities of motion thus calculated from the law of gravitation were found to accord in the most convincing manner with those peculiarities actually observed in the moon's motions which had long perplexed astronomers. The demonstration of the law of gravitation was so complete, as it thus first came from Newton's hands, that within a very short time men of science were thoroughly convinced, and the law of gravitation has not been seriously questioned from that day to this.—PROCTOR *Expanse of Heaven*, p. 113. (L. G. & Co.)

571. COMPREHENSIVENESS OF THE HUMAN MIND—*Man Reads System into Phenomena.*—Through this faculty of invention the whole earth is man's. There is not a lone island fit for his abode whereon some Alexander Selkirk has not made a home. Every mineral, plant, and animal is so far known that a place has been found for it in his *Systema Naturæ*. Every creature is subject to man; the winds, the seas, the sunshine, the lightning do his bidding. Projecting his vision beyond his tiny planet, this inventing animal has catalogued and traced the motion of every star. But his crowning glory (which always fills me with admiration) is his ever-increasing comprehensiveness. After centuries of cultivating acquaintance with the discrete phenomena around him, he has now striven to coordinate them, to make them organic, to read system into them. He has learned by degrees to comprehend all things as parts of a single mechanism. Sir Isaac Newton and Kepler conceived all objects and all worlds to be held by universal gravitation.—MASON *The Birth of Invention. Address at Centenary of Am. Pat. System, Washington, D. C., 1891;* proceedings, p. 403.

572. COMPULSION ABOLISHES MORAL QUALITY OF ACTIONS—If any human action is determined not by any motive whatever, but simply by external or physical compulsion, then no moral element is present at all, and no perception of the moral sense can arise respecting it. Freedom, therefore, in the sense of exemption from such compulsion, must be assumed as a condition of human action absolutely essential to its possessing any moral character whatever.—ARGYLL *Unity of Nature*, ch. 9, p. 197. (Burt.)

573. COMPULSION OF BODY BY MIND—*The "Mountain Sickness"—Milk Refreshes Alpine Climber.*—It is not good to go altogether without food in these climbing expeditions; nor is it good to eat copiously. Here a little and there a little, as the need makes itself apparent, is the prudent course. For, left to itself, the stomach infallibly sickens, and the forces of the system ooze away. Should the sickness have set in so as to produce a recoil from nutriment, the stomach must be forced to yield. A small modicum of food usually suffices to set it right. The strongest guides and the sturdiest porters have sometimes to use this compulsion. . . . On the present occasion I had a bottle of milk, which suits me better than anything else. That and a crust are all I need to keep my vigor up and to ward off *le mal des montagnes.*—TYNDALL *Hours of Exercise in the Alps*, ch. 25, p. 302. (A., 1898.)

574. CONCENTRATION OF INDUSTRY—*The Factory System Antedates Steam—Apprenticeship an Incident.*—And just as Hargreaves and Arkwright and Crompton were inventing the new machines which were to be moved, Watt was laboring at the new power which was to move them. But meanwhile, before the steam-engine had been made available, the factory system had begun under the old motive power of water; and here it is very curious to observe how each stage in the progress of discovery had, by way of natural consequence, its own special effect on the conduct and the wills of men. Very soon the course of every mountain stream in Lancashire and Yorkshire was marked by factories. This again had another consequence. It was a necessity of the case that such factories must generally be situated at a distance from preexisting populations, and, therefore, from a full supply of labor. Consequently they had to create communities for themselves. From this necessity, again, it arose that the earlier mills were worked under a system of apprenticeship. The due attendance of the requisite number of "hands" was secured by engagements which bound the laborer to his work for a definite period.—ARGYLL *Reign of Law*, ch. 7, p. 207. (Burt.)

575. CONCENTRATION OF POWER—*Through a Three-foot Burning-glass the Sun's Heat Vaporizes Diamond—A Partial Revelation of the Heat of the Sun's Surface—Source of Heat Exceeds Its Reflection or Refraction.*—One certain thing is this—that we cannot by any contrivance raise the temperature in the focus of any lens or mirror beyond that of its source (practically we cannot do even so much); we cannot, for instance, by any burning-lens make the

image of a candle as hot as the original flame. Whatever a thermometer may read when the candle-heat is concentrated on its bulb by a lens, it would read yet more if the bulb were dipped in the candle-flame itself; and one obvious application of this fact is that tho we cannot dip our thermometer in the sun, we know that if we could do so the temperature would at least be greater than any we get by the largest burning-glass. We need have no fear of making the burning-glass too big; the temperature at its solar focus is always and necessarily lower than that of the sun itself.

For some reason no very great burning-lens or mirror has been constructed for a long time, and we have to go back to the eighteenth century to see what can be done in this way. . . .

In England, the largest burning-lens on record was made . . . by an optician named Parker for the English Government, who designed it as a present to be taken by Lord Macartney's embassy to the Emperor of China. Parker's lens was three feet in diameter and very massive, being seven inches thick at the center. In its focus the most refractory substances were fused, and even the diamond was reduced to vapor, so that the temperature of the sun's surface is at any rate higher than this.—LANGLEY *New Astronomy*, ch. 4, p. 102. (H. M. & Co.)

576. CONCEPTION, INFINITE, FROM FINITE EXPERIENCE—*Indestructibility of Matter and of Force.*—It is indeed of the highest importance to observe that some of these conceptions, especially the indestructibility of matter and of force, belong to the domain of science. . . . As now accepted and defined, they are the result of direct experiment. And yet, strictly speaking, all that experiment can do is to prove that in all the cases in which either matter or force seems to be destroyed, no such destruction has taken place. Here then we have a very limited and imperfect amount of "experience" giving rise to an infinite conception. But it is another of the suggestions of the agnostic philosophy that this can never be a legitimate result. Nevertheless, it is a fact that these conceptions have been reached. They are now universally accepted and taught as truths lying at the foundation of every branch of natural science—at once the beginning and the end of every physical investigation.—ARGYLL *Unity of Nature*, ch. 4, p. 85. (Burt.)

577. CONCEPTION OF A FINITE CREATOR—*God Himself Viewed as Engaged in the Struggle against Inevitable Evil—Mill's Belief.*—He [John Stuart Mill] does not undertake to suggest how or why the divine power is limited; but he distinctly prefers the alternative which sacrifices the attribute of omnipotence in order to preserve in our conception of Deity the attribute of goodness. According to Mr. Mill, we may regard the all-wise and holy Deity as a creative energy that is perpetually at work in eliminating evil from the universe. His wisdom is perfect, his goodness is infinite, but his power is limited by some inexplicable viciousness in the original constitution of things which it must require a long succession of ages to overcome. In such a view Mr. Mill sees much that is ennobling. The humblest human being who resists an impulse to sin, or helps in the slightest degree to leave the world better than he found it, may actually be regarded as a participator in the creative work of God; and thus each act of human life acquires a solemn significance that is almost overwhelming to contemplate.—FISKE *Through Nature to God*, pt. i, ch. 3, p. 17. (H. M. & Co., 1900.)

578. CONCEPTIONS FOUNDED ON EXPERIENCE—*The "Falling Atoms" of Ancient Philosophy.*—Our conceptions of natural phenomena and their causes are founded on, but they are not bounded by, sensible experience. The eternally falling atoms of Epicurus and Lucretius, for example, were derived from the observation of small particles of matter; but in transforming such particles, by a mental act, into atoms, the ancient philosophers broke ground in an ideal region. The notion of falling indicates the manner in which the ancient mind was conditioned by experience; for in those days, while the action of gravity was known, the action of molecular force, capable of attracting and arranging the atoms, was unknown. The case is representative, the visible world being converted by science into the symbol of an invisible one. We can have no explanation of the objects of experience, without invoking the aid and ministry of objects which lie beyond the pale of experience. We can only reach the roots of natural phenomena by laying down, intellectually, a subsensible soil out of which such phenomena spring.—TYNDALL *Heat a Mode of Motion*, lect. 1, p. 32. (A., 1900.)

579. CONCURRENCE OF EVENTS TO ADVANCE ASTRONOMY—*The "Set Time" of a Great Movement—Herschel "Bursts the Barriers of Heaven."*—Much of this interest was due to the occurrence of events calculated to arrest the attention and excite the wonder of the uninitiated. The predicted return of Halley's comet in 1759 verified, after an unprecedented fashion, the computations of astronomers. It deprived such bodies forever of their portentous character; it ranked them as denizens of the solar system. Again, the transits of Venus in 1761 and 1769 were the first occurrences of the kind since the awakening of science to their consequence. Imposing preparations, journeys to remote and hardly accessible regions, official expeditions, international communications, all for the purpose of observing them to the best advantage, brought their high significance vividly to the public consciousness; a result aided

by the facile pen of Lalande, in rendering intelligible the means by which these elaborate arrangements were to issue in an accurate knowledge of the sun's distance. Lastly, Herschel's discovery of Uranus, March 13, 1781, had the surprising effect of utter novelty. Since the human race had become acquainted with the company of the planets, no addition had been made to their number. The event thus broke with immemorial traditions, and seemed to show astronomy as still young and full of unlooked-for possibilities.—CLERKE *History of Astronomy*, int., p. 5. (Bl., 1893.)

580. CONDEMNATION OF PRESENT JUDGES BRAVED FOR HIGHER APPROVAL (*1 Cor. iv, 3-4*)—*The Highest, God—The "Great Companion."*—When for motives of honor and conscience I brave the condemnation of my own family, club, and "set"; when, as a Protestant, I turn Catholic; as a Catholic, freethinker; as a "regular practitioner," homeopath, or what not, I am always inwardly strengthened in my course and steeled against the loss of my actual social self by the thought of other and better possible social judges than those whose verdict goes against me now. The ideal social self which I thus seek in appealing to their decision may be very remote: it may be represented as barely possible. I may not hope for its realization during my lifetime; I may even expect the future generations, which would approve me if they knew me, to know nothing about me when I am dead and gone. Yet still the emotion that beckons me on is indubitably the pursuit of an ideal social self, of a self that is at least worthy of approving recognition by the highest possible judging companion, if such companion there be. This self is the true, the intimate, the ultimate, the permanent Me which I seek. This judge is God, the Absolute Mind, the "Great Companion."—JAMES *Psychology*, vol. i, ch. 10, p. 315. (H. H. & Co., 1899.)

581. CONDITIONS APPARENTLY SIMILAR PRODUCE DIFFERENT RESULTS—*In Coldest Siberia Glaciers Unknown—Hasty Inferences Untrustworthy.*—A study of the arctic regions quickly impresses one fact upon our minds, viz., the markedly unequal distribution of the larger masses of land-ice. . . . The other islands north of the American continent, tho some are of a fair size and rise to a considerable elevation, nowhere exhibit an accumulation of ice in any way comparable with that of Greenland. The same is true of the northern part of Siberia; the cold there is no less intense than in the north of the other continent. . . . The January temperature of Yakutsk, in latitude 62° north, is as low as — 40° F., and the soil is permanently frozen to a depth of about 700 feet. Yet in all this region, notwithstanding the intense cold, glaciers are unknown. The reason is simple: the air is dry and the snowfall is but light. So far as temperature goes, a glacial epoch rules in Siberia, but no marks of ice-action will be left behind in the event of its departure.—BONNEY *Ice-work, Present and Past*, pt. i, ch. 2, p. 39. (A., 1896.)

582. CONFIDENCE IN COMMON SENSE—Common sense, however, universally feels that analogy is here a safer guide to truth than the skeptical demand for impossible evidence.—ROMANES *Animal Intelligence*, int., p. 6. (A., 1899.)

583. CONFLAGRATION OF A STAR—*News Centuries in Coming.*—Between thirty and fifteen minutes before midnight of May 12, 1866, Mr. John Birmingham, of Millbrook, near Tuam, in Ireland, saw with astonishment a bright star of the second magnitude unfamiliarly situated in the constellation of the Northern Crown. Four hours earlier, Schmidt, of Athens, had been surveying the same part of the heavens, and was able to testify that it was not visibly there; that is to say, a few hours, or possibly a few minutes, sufficed to bring about a conflagration the news of which may have occupied hundreds of years in traveling to us across space. . . . The chief of [the lines observed in the spectrum] agreed in position with lines of hydrogen; so that the immediate cause of the outburst was plainly perceived to have been the eruption, or ignition, of vast masses of that subtle kind of matter the universal importance of which throughout the cosmos is one of the most curious facts revealed by the spectroscope.—CLERKE *History of Astronomy*, pt. ii, ch. 12, p. 473. (Bl., 1893.)

584. ——— ——— *Sudden Brightness of "The Blaze Star"—Possible Conflagration of Our Sun—The "Day of Fire" on Earth.*—Years ago a star suddenly appeared in the constellation of the Northern Crown, shining as a star of the second magnitude. It was found that it occupied the same place as a star of the tenth magnitude, and no doubt now exists that it was this known faint star which had thus suddenly acquired a new brilliancy: for tho the star soon lost its great brightness, it can still be seen, as before, as a star of about the tenth magnitude. Now, when the star (appropriately called the Blaze Star) came to be examined with the spectroscope, it was found that a great portion of its light came from glowing hydrogen. Doubtless, by some circumstances the exact nature of which we shall never know, there had been a tremendous conflagration in that distant star. It was estimated that the brightness of the star increased fully eight hundredfold while this conflagration was in progress. If a change such as this took place in our own sun—and who shall say that such a change is impossible?—the prophecy of St. Peter would be fulfilled: "The day of the Lord will come as a thief in the night; in the

which the heavens shall pass away with a great noise; and the elements shall melt with fervent heat: the earth also and the works that are therein shall be burned up" [2 Peter iii, 10]. For aught that is certainly known, the mere daily continuance of the sun's light and heat may be due to causes which need only be excited to unusual activity to produce such a catastrophe. . . . Sometimes there are outbursts in the sun which suggest very significantly the possibility of much more terrible, because more general, catastrophes.—PROCTOR *Expanse of Heaven*, p. 199. (L. G. & Co., 1897.)

585. CONFLAGRATION ON THE SUN—" *A Prairie on Fire*"—*Chromosphere and Prominences.*—At its base [of the sun's corona], and in contact with the photosphere, is what resembles a sheet of scarlet fire. The appearance, which probably indicates a fact, is as if countless jets of heated gas were issuing through vents and spiracles over the whole surface, thus clothing it with flame which heaves and tosses like the blaze of a conflagration—" like a prairie on fire," to quote the vividly descriptive phrase of Professor Langley. This has received the name of chromosphere. . . .

Here and there masses of this hydrogen mixed with other substances rise to a great height, ascending far above the general level into the coronal regions, where they float like clouds, or are torn to pieces by contending currents. These cloud-masses are known as solar " prominences," or " protuberances," a non-committal sort of appellation applied in 1842, when they first attracted any considerable attention, and while it was a warmly disputed question whether they were solar, lunar, phenomena of our own atmosphere, or even mere optical illusions. It is unfortunate that no more appropriate and graphic name has yet been found for objects of such wonderful beauty and interest.—YOUNG *The Sun*, ch. 6, p. 192. (A., 1898.)

586. ——— ——— *Simultaneous and Wild Agitation of the Magnetic Needle—Aurora Borealis.*—On September 1, 1859, two astronomers, Carrington and Hodgson, were observing the sun, independently of each other, the first on a screen which received the image, the second directly through a telescope, when. in a moment, a dazzling flash blazed out in the midst of a group of spots. This light sparkled for five minutes above the spots without modifying their form, as if it were completely independent, and yet it must have been the effect of a terrible conflagration occurring in the solar atmosphere. Each observer ascertained the fact separately, and was for an instant dazzled. Now, here is a surprising coincidence: at the very moment when the sun appeared inflamed in this region the magnetic instruments of the Kew Observatory, near London, where they were observing, manifested a strange agitation; the magnetic needle jumped for more than an hour as if infatuated. Moreover, a part of the world was on that day and the following one enveloped in the fires of an aurora borealis, in Europe as well as in America. It was seen almost everywhere: at Rome, at Calcutta, in Cuba, in Australia, and in South America. Violent magnetic perturbations were manifested, and at several points the telegraph lines ceased to act. Why should these two curious events not be associated with each other?—FLAMMARION *Popular Astronomy*, bk. iii, ch. 5, p. 290. (A.)

587. CONFLICT OF TESTIMONY—*Personal Difference of Observation Universal among Astronomers.*—When the errors dependent upon accidental circumstances have all been eliminated, these measurements still show differences between different observers. They persist even when there is no external reason discoverable. The fact was first noticed in the annals of the Greenwich Observatory for 1795. The astronomer writes that he dismissed his assistant as unreliable because he had acquired the habit of seeing all stellar transits half a second too late. Not till many decades later was the scientific honor of the assistant vindicated. It was the celebrated German astronomer Bessel who proved that this difference between two observers is only a special case of a phenomenon of universal occurrence. Bessel compared his own results with those of other astronomers, and came to the surprising conclusion that it is hardly possible to find two observers who put the passage of a star at precisely the same time, and that the personal differences may amount to a whole second. These observations were confirmed at all observatories.—WUNDT *Human and Animal Psychology*, ch. 18, § 2, p. 268. (Son. & Co., 1898.)

588. ——— ——— *Surprise Disqualifies for Observation—Disagreement in First Accounts of the Sun's Halo.*—In this halo we notice tongues of fire which emanate from the sun and are contiguous to him. It was during the eclipse of July 8, 1842, that the attention of astronomers was first attracted to these prominences, which shoot forth round the moon like gigantic flames of a rose or peach color (they had already been seen with the naked eye, especially in 1239, in 1560, 1605, 1652, 1706, 1724, 1733, and 1766, but astronomers believed them to be optical illusions). The surprise produced by this unexpected phenomenon did not permit exact observations to be made, so that there was a complete disagreement between the different accounts. Baily noticed 'three enormous prominences, almost uniformly distributed on the same side.

Airy observed three, in the form of the teeth of a saw, but placed at the summit. Arago saw two at the lower part of the disk. At Verona these flames remained vis-

ible after the appearance of the sun.—FLAMMARION *Popular Astronomy*, bk. iii, ch. 4, p. 263. (A.)

589. ——— ——— *Unimpeachable Witnesses Disagree.*—The most extraordinary thing, however [in the eclipse of 1878, seen from Pike's Peak], was a beam of light, inclined at an angle of about forty-five degrees, about as wide as the sun, and extending to the distance of nearly six of its diameters on one side and over twelve on the other; on one side alone, that is, to the amazing distance of over ten million miles from its [the sun's] body. Substantially the same observation was made, as it appeared later, by Professor Newcomb, at a lower level. The direction, when more carefully measured, it was interesting to note, coincided closely with that of the zodiacal light, and a faint central rib added to its resemblance to that body. It is noteworthy, in illustration of what has already been said as to the conflict of ocular testimony, that tho I, with the great majority of observers below, saw only this beam, two witnesses whose evidence is unimpeachable, Professors Young and Abbe, saw a pale beam at right angles to it; and that one observer did not see the beam in question at all.—LANGLEY *New Astronomy*, ch. 2, p. 55. (H. M. & Co., 1896.)

590. CONFLICT, SEEMING, OF SCIENCE AND RELIGION—*Science Not to Be Silenced by Dogma.*—When, therefore, the disturbing elements of scientific assertion and inquiry shock the religious beliefs of the individual, the sect, or the nation at large, what procedure or line of conduct does it become every earnest and cultured person to follow? Certainly not that of bewailing the destruction, apparent or real, of his temples of belief; not that of bemoaning the razing to the ground of those tents wherein he has so long and comfortably dwelt; and not that, assuredly, of asserting that, because his fathers worshiped in this mountain or in that, he must therefore and of necessity do the same. No; if our beliefs are attacked, and if they are worth defending at all, let us be up and doing. Meet your opponents with their own weapons. Do not go forth with old dogmas to meet scientific truths, as with the armor of medieval times against the weapons of to-day. Study science for yourselves; meet scientific fact and assertion by counter-assertion and counter-fact. You will find that in science, more, perhaps, than in commonplace things, there are always two sides to every great question; and you will never fight or gain your battle more readily, or more honestly, than by testing every point by your own knowledge, and by opposing to the advance of your adversaries a barrier of like kind to that which forms their most potent means of offense.—ANDREW WILSON *Science Culture for the Masses*, p. 33. (Hum., 1888.)

591. CONNECTION OF PHYSICAL PHENOMENA — *The Study of Science — A Unity behind the Facts.*—In considering the study of physical phenomena, not merely in its bearings on the material wants of life, but in its general influence on the intellectual advancement of mankind, we find its noblest and most important result to be a knowledge of the chain of connection by which all natural forces are linked together and made mutually dependent upon each other; and it is the perception of these relations that exalts our views and ennobles our enjoyments. Such a result can, however, only be reaped as the fruit of observation and intellect, combined with the spirit of the age, in which are reflected all the varied phases of thought.—HUMBOLDT *Cosmos*, vol. i, int., p. 23. (H., 1897.)

592. CONQUEST HAS UNINTENDED RESULT—*Human Brotherhood Strangely Advanced by War.*—"The impetuous conquests of Alexander, the more politic and premeditated extension of territory made by the Romans, the wild and cruel incursions of the Mexicans, and the despotic acquisitions of the Incas, have in both hemispheres contributed to put an end to the separate existence of many tribes as independent nations, and tended at the same time to establish more extended international amalgamation. Men of great and strong minds, as well as whole nations, acted under the influence of one idea, the purity of which was, however, utterly unknown to them. It was Christianity which first promulgated the truth of its exalted charity, altho the seed sown yielded but a slow and scanty harvest. Before the religion of Christ manifested its form, its existence was only revealed by a faint foreshadowing presentiment. In recent times, the idea of civilization has acquired additional intensity, and has given rise to a desire of extending more widely the relations of national intercourse and of intellectual cultivation; even selfishness begins to learn that by such a course its interests will be better served than by violent and forced isolation. Language, more than any other attribute of mankind, binds together the whole human race. By its idiomatic properties it certainly seems to separate nations, but the reciprocal understanding of foreign languages connects men together, on the other hand, without injuring individual national characteristics." [Quoted from Wilhelm von Humboldt.]—HUMBOLDT *Cosmos*, vol. i, p. 359. (H., 1897.)

593. CONQUEST OF NATURE BY SAVAGE MAN—*A House and Feast in the South Sea Islands—Fire Kindled by Friction.*—By the aid of strips of bark for rope, the stems of bamboos for rafters, and the large leaf of the banana for a thatch, the Tahitians in a few minutes built us an excellent house, and with withered leaves made a soft bed. They then proceeded to make a fire and cook our evening meal. A light was procured by rubbing a blunt-pointed stick in a groove made in another,

as if with intention of deepening it, until by the friction the dust became ignited. A peculiarly white and very light wood is alone used for this purpose. . . . The fire was produced in a few seconds; but to a person who does not understand the art, it requires, as I found, the greatest exertion; but at last, to my great pride, I succeeded in igniting the dust. . . . The Tahitians, having made a small fire of sticks, placed a score of stones, of about the size of cricket-balls, on the burning wood. In about ten minutes the sticks were consumed and the stones hot. They had previously folded up in small parcels of leaves pieces of beef, fish, ripe and unripe bananas, and the tops of the wild arum. These green parcels were laid in a layer between two layers of the hot stones, and the whole then covered up with earth, so that no smoke or steam could escape. In about a quarter of an hour, the whole was most deliciously cooked. The choice green parcels were now laid on a cloth of banana-leaves, and with a coconut-shell we drank the cool water of the running stream; and thus we enjoyed our rustic meal.—DARWIN *Naturalist's Voyage around the World*, ch. 18, p. 409. (A., 1898.)

594. CONQUESTS OF SCIENCE—*Warriors Accomplished Less than Peaceful Travelers.*—Altho in Columbus a capacity for exact observation was developed in manifold directions, notwithstanding his entire deficiency of all previous knowledge of natural history, and solely by contact with great natural phenomena, we must by no means assume a similar development in the rough and warlike body of the conquistadores. Europe owes to another and more peaceful class of travelers, and to a small number of distinguished men among municipal functionaries, ecclesiastics, and physicians, that which it has unquestionably acquired by the discovery of America, in the gradual enrichment of its knowledge regarding the character and composition of the atmosphere, and its action on the human organization; the distribution of climates on the declivities of the Cordilleras; the elevation of the line of perpetual snow in accordance with the different degrees of latitude in both hemispheres; the succession of volcanoes; the limitation of the circles of commotion in earthquakes; the laws of magnetism; the direction of oceanic currents, and the gradations of new animal and vegetable forms. The class of travelers to whom we have alluded, by residing in native Indian cities, some of which were situated twelve or thirteen thousand feet above the level of the sea, were enabled to observe with their own eyes, and, by a continued residence in those regions, to test and to combine the observations of others, to collect natural products, and to describe and transmit them to their European friends. It will suffice here to mention Gomara, Oviedo, Acosta, and Hernandez.—HUMBOLDT *Cosmos*, vol. ii, pt. ii, p. 273. (H., 1897.)

595. CONSCIENCE ACTIVE IN OPIUM-EATER—*Paralysis of Will—De Quincey.*—"The opium-eater loses none of his moral sensibilities or aspirations: he wishes and longs, as earnestly as ever, to realize what he believes possible and feels to be exacted by duty; but his intellectual apprehension of what is possible infinitely outruns his power, not of execution only, but of power to attempt. He lies under the weight of incubus and nightmare: he lies in sight of all that he would fain perform, just as a man forcibly confined to his bed by the mortal languor of a relaxing disease, who is compelled to witness injury or outrage offered to some object of his tenderest love—he curses the spells which chain him down from motion—he would lay down his life if he might but get up and walk; but he is powerless as an infant, and cannot even attempt to rise." [De Quincey, op. cit., pp. 136-138.]—CARPENTER *Mental Physiology*, bk. 2, ch. 17, p. 648. (A., 1900.)

596. CONSCIENCE, AGGREGATE, CONTROLLING INDIVIDUAL—*Laws Invariable—Combinations Subject to Change.*—As the reason and the conscience of the whole political community can interfere by the exercise of authority, so also may adequate remedies be found in the reason and the conscience of voluntary societies. The external conditions which tell upon the individual will are themselves very often nothing but conditions depending on the aggregate will of those around us; and if upon them, by any means, new motives can be brought to bear, then the whole of those external conditions may be changed. . . . It is often said that the conduct and condition of men are governed by invariable laws: and the conclusion is that the evils which arise by way of natural consequence out of the action of those laws are evils against which the struggles of the will are hopeless. But the facts on which this conclusion is founded are, as usual, inaccurately stated. The conditions of human life and conduct, like the conditions of all natural phenomena, are never governed by those separate and individual forces which alone are invariable, but always by combinations among those forces—which combinations are of endless variety, and of endless capability of change.—ARGYLL *Reign of Law*, ch. 7, p. 218. (Burt.)

597. CONSCIENCE, THE UNIVERSAL BELIEF OF MANKIND—*Formation of Character the Great Aim.*—The idea of "responsibility," on the other hand, which is entertained by mankind at large, rests upon the assumption, not only that each ego has a conscience which recognizes a distinction between right and wrong, and which (according to the training it has received) decides

what is right and what is wrong in each individual case, but also that he has a volitional power which enables him to intensify his sense of "duty" by fixing his attention upon it, and thus gives it a potency in determining his conduct which it might not have otherwise possessed. That this power is a part of the ego's "formed character," and that it can only be exerted within certain limits, is fully admitted on the doctrine I advocate; but the responsibility of the ego is shifted backwards to the share he has had in the formation of his character and in the determination of those limits. And here, again, the results of scientific investigation are in complete harmony with the precepts of the greatest of all religious teachers. For no one can study these with care without perceiving that Jesus and Paul addressed themselves rather to the formation of the character than to the laying down rules for conduct; that they endeavored rather to cultivate the dispositions which should lead to right action than to fix rigid lines of duty the enforcement of which under other circumstances might be not only unsuitable, but actually mischievous; and that they not only most fully recognized the power of each individual to direct the habitual course of his thoughts, to cherish his nobler affections, and to repress his sensual inclinations, but made the possession of that power the basis of the entire system of Christian morality.—CARPENTER *Mental Physiology*, pref., p. 46. (A., 1900.)

598. CONSCIOUSNESS AND ATOMIC MOTION DIFFERENT IN KIND—"Thus far our way is clear, but now comes my difficulty. Your atoms are individually without sensation, much more are they without intelligence. May I ask you, then, to try your hand upon this problem. Take your dead hydrogen atoms, your dead oxygen atoms, your dead carbon atoms, your dead nitrogen atoms, your dead phosphorus atoms, and all the other atoms, dead as grains of shot, of which the brain is formed. Imagine them separate and sensationless; observe them running together and forming all imaginable combinations. This, as a purely mechanical process, is seeable by the mind. But can you see, or dream, or in any way imagine, how out of that mechanical act, and from these individually dead atoms, sensation, thought, and emotion are to rise? Are you likely to extract Homer out of the rattling of dice, or the differential calculus out of the clash of billiard-balls? . . . I can follow a particle of musk until it reaches the olfactory nerve; I can follow the waves of sound until their tremors reach the water of the labyrinth, and set the otoliths and Corti's fibers in motion; I can also visualize the waves of ether as they cross the eye and hit the retina. Nay, more. I am able to pursue to the central organ the motion thus imparted at the periphery, and to see in idea the very molecules of the brain thrown into tremors. My insight is not baffled by these physical processes. What baffles and bewilders me is the notion that from those physical tremors things so utterly incongruous with them as sensation, thought, and emotion can be derived." [Supposed quotation from Bishop Butler.] —TYNDALL *Fragments of Science (the Belfast Address)*, vol. ii, ch. 9, p. 167. (A., 1900.)

599. CONSCIOUSNESS AN UNRESTING STREAM—*Not an Assemblage of Molded Forms—Mind Not to Be Measured Off into Departments.*—The traditional psychology talks like one who should say a river consists of nothing but pailsful, spoonsful, quartpotsful, barrelsful, and other molded forms of water. Even were the pails and the pots all actually standing in the stream, still between them the free water would continue to flow. It is just this free water of consciousness that psychologists resolutely overlook. Every definite image in the mind is steeped and dyed in the free water that flows round it. With it goes the sense of its relations, near and remote, the dying echo of whence it came to us, the dawning sense of whither it is to lead. The significance, the value, of the image is all in this halo or penumbra that surrounds and escorts it—or rather that is fused into one with it and has become bone of its bone and flesh of its flesh; leaving it, it is true, an image of the same thing it was before, but making it an image of that thing newly taken and freshly understood.—JAMES *Psychology*, vol. i, ch. 9, p. 255. (H. H. & Co., 1899.)

600. CONSCIOUSNESS AS A STAGE—*Ideas as Actors, Appearing and Disappearing—Comparison Misleading—Unconscious Idea Also Unknown—Same Idea Never Returns.*—Nothing is more natural than to think of consciousness as a kind of stage upon which our ideas are the actors, appearing, withdrawing behind the scenes, and coming on again when their cue is given. . . . Nevertheless this comparison of consciousness to a stage is entirely misleading. The stage remains when the actors have left it; it has an existence of its own, which is not dependent upon them. But consciousness does not continue to exist when the processes of which we are conscious have passed away; it changes constantly with their changes, and is not anything which can be distinguished from them. When the actor has left the stage, we know that he is somewhere else. But when an idea has disappeared from consciousness we know nothing at all about it. Strictly speaking, it is not correct to say that it subsequently returns. For the same idea never returns. A subsequent idea may be more or less similar to an earlier one; but it is probably never exactly the same.—WUNDT *Psychology*, lect. 16, p. 235. (Son. & Co., 1896.)

601. CONSCIOUSNESS, CONTINUITY OF—*Individuality Endures through All Change—Sleep Does Not Sunder.*—When Paul and Peter wake up in the same bed, and recognize that they have been asleep, each one of them mentally reaches back and makes connection with but one of the two streams of thought which were broken by the sleeping hours. As the current of an electrode buried in the ground unerringly finds its way to its own similarly buried mate, across no matter how much intervening earth, so Peter's present instantly finds out Peter's past, and never by mistake knits itself on to that of Paul. Paul's thought in turn is as little liable to go astray. The past thought of Peter is appropriated by the present Peter alone. He may have a knowledge, and a correct one, too, of what Paul's last drowsy states of mind were as he sank into sleep, but it is an entirely different sort of knowledge from that which he has of his own last states. He remembers his own states, whilst he only conceives Paul's. . . . This community of self is what the time-gap cannot break in twain, and is why a present thought, altho not ignorant of the time-gap, can still regard itself as continuous with certain chosen portions of the past. . . . A "river" or a "stream" are the metaphors by which it is most naturally described.—JAMES *Psychology*, vol. i, ch. 9, p. 238. (H. H. & Co., 1890.)

602. CONSCIOUSNESS DEAD TO EVER-PRESENT FACT—*Sound Always in the Ear Never Heard.*—It is a law of nervous stimulation that a continued activity of any structure results in less and less psychic result, and that when a stimulus is always at work it ceases in time to have any appreciable effect. The common illustration of this law is drawn from the region of sound. A constant noise, as of a mill, ceases to produce any conscious sensation. This fact, it is plain, may easily become the commencement of an illusion. Not only may we mistake a measure of noise for perfect silence, we may misconceive the real nature of external circumstances by overlooking some continuous impression.—SULLY *Illusions*, ch. 4, p. 56. (A., 1897.)

603. CONSCIOUSNESS DEPENDS ON CONTRAST—*An Unvarying Sensation Is Unperceived—Incessant Ticking of Clock.*—It is a familiar observation that an unvarying action on any of our senses has, when long continued, the same effect as no action at all. We are not conscious of the pressure of the atmosphere. An even temperature, such as that enjoyed by the fishes in the tropical seas, leaves the mind an entire blank as regards heat and cold. The feeling of warmth is not an absolute, independent, or self-sustaining condition of mind, but the result of a transition from cold; the sensation of light supposes a transition from darkness or shade, or from a less degree of illumination to a greater. To use a familiar illustration, a watchmaker is not conscious of the unintermitted ticking of his clocks; but were they all suddenly stopped, he would at once become aware of the blank.—BAIN *Mind and Body*, ch. 4, p. 12. (Hum., 1880.)

604. ——— ——— *Enjoyment by Transition—Advantages of Wealth.*—People are generally aware that the first shock of transition from sickness to health, from poverty to abundance, from ignorance to insight, is the most intense; and that, as the memory of the previous condition fades away, so does the liveliness of the enjoyment of the change. Shakespeare speaks of the miser's looking but rarely at his hoards for fear of "blunting the fine point of seldom pleasure"; and makes the versatile Prince Hal say that

"If all the year were playing holidays,
To sport would be as tedious as to work."

The blessings of leisure, retirement, and rest are pleasant only by contrast to previous toil and excitement. The incessant demand for novelty and change, for constant advances in wealth, in knowledge, in the arrangements of things about us—attest the existence and the power of the law of relativity in all the provisions for enjoyment. It is a law that greatly neutralizes one part of the advantages of superior fortune, the sense of the superiority itself, but leaves another part untouched—namely, the range, variety, and alternation of pleasures.—BAIN *Mind and Body*, ch. 4, p. 12. (Hum., 1880.)

605. CONSCIOUSNESS NOT A PRODUCT OF PHYSICAL FORCES—*Nature of the Soul Still a Mystery (Eccl. iii, 21).*—Whence came the soul we no more know than we know whence came the universe. The primal origin of consciousness is hidden in the depths of the bygone eternity. That it cannot possibly be the product of any cunning arrangement of material particles is demonstrated beyond peradventure by what we now know of the correlation of physical forces.—FISKE *Destiny of Man*, ch. 5, p. 42. (H. M. & Co., 1900.)

606. CONSCIOUSNESS NOT EXPLICABLE BY MECHANICAL OR MOLECULAR THEORY—We may even affirm that the brain of man—the organ of his reason—without which he can neither think nor feel, is also an assemblage of molecules, acting and reacting according to law. Here, however, the methods pursued in mechanical science come to an end; and if asked to deduce from the physical interaction of the brain molecules the least of the phenomena of sensation or thought, I acknowledge my helplessness. The association of both with the matter of the brain may be as certain as the association of light with the rising of the sun. But whereas in the latter case we have unbroken mechanical connection between the sun and our organs, in the former

case logical continuity disappears. Between molecular mechanics and consciousness is interposed a fissure over which the ladder of physical reasoning is incompetent to carry us.—TYNDALL *Fragments of Science*, vol. ii, ch. 15, p. 388. (A., 1900.)

607. CONSCIOUSNESS PERSISTS IN SLEEP—*Waking Ideas Control—"A Dream Cometh through the Multitude of Business" (Eccl. v, 3).*—Our dream-operations have been found to have a much closer connection with our waking experiences than could be supposed on a superficial view. The materials of our dreams are seen, when closely examined, to be drawn from our waking experience. Our waking consciousness acts in numberless ways on our dreams, and these again in unsuspected ways influence our waking mental life. Not only so, it is found that the quaint chaotic play of images in dreams illustrates mental processes and laws which are distinctly observable in waking thought. Thus, for example, the apparent objective reality of these visions has been accounted for, without the need of resorting to any supernatural agency, in the light of a vast assemblage of facts gathered from the byways, so to speak, of waking mental life.—SULLY *Illusions*, ch. 7, p. 130. (A., 1897.)

608. CONSCIOUSNESS, POWER OF—*Influences the Bodily Life.*—The particulars of the distribution of consciousness, so far as we know them, point to its being efficacious. It is very generally admitted, tho the point would be hard to prove, that consciousness grows the more complex and intense the higher we rise in the animal kingdom. That of a man must exceed that of an oyster. From this point of view it seems an organ, superadded to the other organs which maintain the animal in the struggle for existence; and the presumption, of course, is that it helps him in some way in the struggle, just as they do. But it cannot help him without being in some way efficacious and influencing the course of his bodily history. If now it could be shown in what way consciousness *might* help him, and if, moreover, the defects of his other organs . . . are such as to make them need just the kind of help that consciousness would bring provided it *were* efficacious; why, then the plausible inference would be that it came just *because* of its efficacy—in other words, its efficacy would be inductively proved.—JAMES *Psychology*, vol. i, ch. 5, p. 138. (H. H. & Co., 1899.)

609. CONSCIOUSNESS REPUDIATES MATERIALISM—*The Soul Not a Combination of Atoms.*—To be sure, we cannot, no, we cannot be satisfied with that practical outcome of psychology, with those conclusions about the final character of personality and freedom [as mere psychophysical processes " for nobody, for no end, and with no value "], about history and logic and ethics, about man and the universe. Every fiber in us revolts, every value in our real life rejects such a construction. We do not feel ourselves such conglomerates of psychophysical elements, and the men whom we admire and condemn, love and hate, are for us not identical with those combinations of psychical atoms which pull and push one another after psychological laws. We do not mean, with our responsibility and with our freedom in the moral world, that our consciousness is the passive spectator of psychological processes which go on causally determined by laws, satisfied that some of the causes are inside our skull, and not outside. The child is to us in real life no vegetable which can be raised like tomatoes, and the criminal is no weed which does not feel that it destroys the garden.—MÜNSTERBERG *Psychology and Life*, p. 15. (H. M. & Co., 1899.)

610. CONSCIOUSNESS SUSPENDED—*Effect of a Lightning-stroke.*—On June 30, 1788, a soldier in the neighborhood of Mannheim, being overtaken by rain, placed himself under a tree, beneath which a woman had previously taken shelter. He looked upwards to see whether the branches were thick enough to afford the required protection, and, in doing so, was struck by lightning, and fell senseless to the earth. The woman at his side experienced the shock in her foot, but was not struck down. Some hours afterwards the man revived, but remembered nothing about what had occurred, save the fact of his looking up at the branches. This was his last act of consciousness, and he passed from the conscious to the unconscious condition without pain.—TYNDALL *Fragments of Science*, vol. i, ch. 21, p. 442. (A., 1900.)

611. CONSERVATION OF ENERGY—*Heat, Light, Magnetism, Electricity, and Motion Convertible.*—The phrase "conservation of energy" does not cover the whole subject that it is intended to cover. It involves the correlation of energy, or, as it has been called in earlier times, the correlation of forces, as well as the transmutation of energy, by which is meant a change from one form to another. For instance, heat as an energy may be converted into another form called electricity, and this in turn may be reconverted into heat. This process is called transmutation. The energy, as such, representing a definite amount of work, remains the same in both cases. Heat, light, magnetism, electricity, are all different modes or forms of energy working through motion; the fact that they are interchangeable is their "correlation"; the fact that the amount of energy remains the same through all changes is its "conservation." Energy is a constant quantity.—ELISHA GRAY *Nature's Miracles*, vol. ii, ch. 1, p. 2. (F. H. & H., 1900.)

612. ——— ——— *Heat Stored in Lime —Given Back in "Slacking."*—Lime is produced from ordinary limestone by burning it in kilns, where it is subjected to a heat of a certain temperature for a number of hours. The heat drives off the carbon dioxid, which, as we have seen, has taken away from each molecule of the compound all of the carbon and two atoms of the oxygen, while all of the calcium is retained with one atom of oxygen, leaving ordinary lime. Lime, then, is simply oxid of calcium. As all know, it is used almost exclusively for making mortar for building purposes. In order to do this we have to put it through the process of "slacking," by pouring water upon it, and here another chemical change takes place. The water unites with the lime, when immediately the heat that was expended in throwing off the carbon dioxid and was stored in the lime as energy is now given up again in the form of heat. When a considerable bulk of lime is slacked very rapidly the heat that is given off is so great that it will produce combustion. Here is a beautiful illustration of what has been erroneously called "latent heat." It is "heat stored as potential energy" that is released by the combination of lime with water.—ELISHA GRAY *Nature's Miracles*, vol. i, ch. 2, p. 17. (F. H. & H., 1900.)

613. ——— ——— *The Sun's Heat the Source of Terrestrial Motion.*—The law of the conservation of energy implies that in any limited system of bodies, whether a steam-engine or the solar system, no change can occur in the total amount of the energy it contains unless fresh energy comes to it from without, or is lost by transmission to bodies outside it. But as, in the case of the sun, some heat is certainly lost by radiation into space unless an equal amount comes in from the stellar universe, the system must be cooling, and in sufficient time would lose all its heat, and therefore much of its energy. The chief use of the principle is to teach us what becomes of force expended without any apparent result, as when a ball falls to the ground and comes to rest. We now know that the energy of the falling ball is converted into heat, which, if it could be all preserved and utilized, would again raise the ball to the height from which it fell. It also enables us to trace most of the energy around us, whether of wind, or water, or of living animals, to the heat and light of the sun. Wind is caused by inequalities of the sun's heat on the earth; all water-power is due to evaporation by the sun's heat, which thus transfers the water from the ocean surface to the mountains, producing rivers; solar heat alone gives power to plants to absorb carbonic acid and build up their tissues, and the energy thus locked up is again liberated during the muscular action of the animals which have fed directly or indirectly on the plants.—WALLACE *The Wonderful Century*, ch. 7, p. 52. (D. M. & Co., 1899.)

614. ——— ——— *Why Does the Sun Not Burn Out?—A Problem Yet Unsolved.*—Thought has, in many directions, been profoundly modified by Mayer's and Joule's discovery, in 1842, of the equivalence between heat and motion. Its corollary was the grand idea of the "conservation of energy," now one of the cardinal principles of science. This means that, under the ordinary circumstances of observation, the old maxim *ex nihilo nihil fit* applies to force as well as to matter. The supplies of heat, light, electricity, must be kept up, or the stream will cease to flow. The question of the maintenance of the sun's heat was thus inevitably raised; and with the question of maintenance that of origin is indissolubly connected.

Dr. Julius Robert Mayer, a physician residing at Heilbronn, . . . showed that if the sun were a body either simply cooling or in a state of combustion, it must long since have "gone out." Had an equal mass of coal been set alight, four or five centuries after the building of the Pyramid of Cheops, and kept burning at such a rate as to supply solar light and heat during the interim, only a few cinders would now remain in lieu of our undiminished glorious orb.—CLERKE *History of Astronomy*, pt. ii, ch. 9, p. 376. (Bl., 1893.)

615. CONSISTENCY OF PROGRESS —*Mind Required to Construe the World—What to Construct It?—Design Transferred from Phenomena to Law.*—As the doctrine of natural selection out of an endless diversity of "aimless" variations fails to account for that general consistency of the advance along definite lines of progress which is manifested in the history of evolution, . . . it leaves untouched the evidence of design in the original scheme of the organized creation; while it transfers the idea of that design from the particular to the general, making all the special cases of adaptation the foreknown results of the adoption of that general order which we call law. As Dr. Martineau has pertinently asked: "If it takes mind to construe the world, how can it require the negation of mind to constitute it?" Science, being the intellectual interpretation of Nature, cannot possibly disprove its origin in mind; and, if rightly pursued, leads us only to a higher comprehension of the "bright designs," a more assured recognition of the working of the "sovereign will," of its divine author.—CARPENTER *Nature and Man*, lect. 15, p. 463. (A., 1889.)

616. CONSTANCY, IMPORTANCE OF —*History of Drinking Water a Determining Element.*—It is generally only possible to form an accurate judgment of a water from watching its history—that is, not from one examination only, but from a series of observations. A water yielding a steady standard of bacterial contents is a much more satisfactory water, from every point of view,

than one which is unstable, one month possessing 500 bacteria per c. c. and another month 5,000.—NEWMAN *Bacteria*, ch. 2, p. 51. (G. P. P., 1899.)

617. CONSTANCY OF LAWS OF NATURE—*Adapts Universe for Rational Beings.*—Unless the laws of Nature were constant, in so far as our experience extends, we could have no certain basis either for science or for practical life. All would be capricious and uncertain, and we could calculate on nothing. Law thus adapts the universe to be the residence of rational beings, and nothing else could.—DAWSON *Facts and Fancies in Modern Science*, lect. 1, p. 39. (A. B. P. S.)

618. ——— ——— *Altitude Determined by Boiling-point.*—As we ascend a mountain, the pressure of the atmosphere above us diminishes, and the boiling-point is correspondingly lowered. On an August morning in 1859 I found the temperature of boiling water on the summit of Mont Blanc to be 184.95° F.; that is, about twenty-seven degrees lower than the boiling-point at the sea-level. On August 3, 1858, the temperature of boiling water on the summit of the Finsteraarhorn was 187° F. On August 10, 1858, the boiling-point on the summit of Monte Rosa was 184.92° F. The boiling-point on Monte Rosa is shown by these observations to be almost the same as it was found to be on Mont Blanc, tho the latter exceeds the former in height by 500 feet. The fluctuations of the barometer are, however, quite sufficient to account for this anomaly. The lowering of the boiling-point is about 1° F. for every 590 feet of elevation; and from the temperature at which water boils we may approximately infer the height.—TYNDALL *Heat a Mode of Motion*, lect. 6, p. 100. (A., 1900.)

619. CONSTANCY OF VISION—*Ancient Same as Modern—Six or Seven Stars Seen in the Pleiades.*—However diversified the power of vision may be in different persons, there is nevertheless a certain average of organic capacity, which was the same among former generations, as, for instance, the Greeks and Romans, as at the present day. The Pleiades prove that several thousand years ago, even as now, stars which astronomers regard as of the seventh magnitude were invisible to the naked eye of average visual power. The group of the Pleiades consists of one star of the third magnitude, Alcyone; of two of the fourth, Electra and Atlas; of three of the fifth, Merope, Maia, and Taygeta; of two between the sixth and the seventh magnitudes, Pleione and Celæno; of one between the seventh and the eighth, Asterope; and of many very minute telescopic stars. I make use of the nomenclature and order of succession at present adopted, as the same names were among the ancients in part applied to other stars. The six first-named stars of the third, fourth, and fifth magnitudes were the only ones which could be readily distinguished. Of these Ovid says (Fast., iv, 170):

"Quæ septem dici, sex tamen esse solent."
[Which are called seven, but are usually seen as six.]

One of the daughters of Atlas, Merope, the only one who was wedded to a mortal, was said to have veiled herself for very shame, or even to have wholly disappeared. This is probably the star of about the seventh magnitude which we call Celæno; for Hipparchus, in his commentary on Aratus, observes that on clear moonless nights seven stars may actually be seen. Celæno, therefore, must have been seen, for Pleione, which is of equal brightness, is too near to Atlas, a star of the fourth magnitude.—HUMBOLDT *Cosmos*, vol. iii, p. 48. (H., 1897.)

620. ——— ——— *The Same Constellations Recognized by Rudest Nations.*—Amid the innumerable multitude of great and small stars, which seem scattered, as it were by chance, throughout the vault of heaven, even the rudest nations separate single (and almost invariably the same) groups, among which certain bright stars catch the observer's eye, either by their proximity to each other, their juxtaposition, or, in some cases, by a kind of isolation. This fact has been confirmed by recent and careful examinations of several of the languages of so-called savage tribes. Such groups excite a vague sense of the mutual relation of parts, and have thus led to their receiving names which, altho varying among different races, were generally derived from organic terrestrial objects. Amid the forms with which fancy animated the waste and silent vault of heaven, the earliest groups thus distinguished were the seven-starred Pleiades, the seven stars of the Great Bear, subsequently (on account of the repetition of the same form) the constellation of the Lesser Bear, the belt of Orion (Jacob's staff), Cassiopeia, the Swan, the Scorpion, the Southern Cross (owing to the striking difference in its direction before and after its culmination), the Southern Crown, the Feet of the Centaur (the Twins, as it were, of the southern hemisphere), etc.—HUMBOLDT *Cosmos*, vol. iii, p. 117. (H., 1897.)

621. CONSTITUENTS OF THE SUN—*Rays of Nucleus and Photosphere Conflict—Fraunhofer's Lines.*—The sun, according to Kirchhoff, consists of a central orb, molten or solid, of exceeding brightness, which emits all kinds of rays, and would therefore, if unhindered, give a continuous spectrum. The radiation from the nucleus, however, has to pass through the photosphere, and this vaporous envelope cuts off those particular rays of the nucleus which it can itself emit—the lines of Fraunhofer marking the position of the failing rays. Could we abolish the central orb, and obtain

the spectrum of the gaseous envelope alone, we should obtain a striped spectrum, each bright band of which would coincide with one of Fraunhofer's dark lines. These lines, therefore, are spaces of relative, not of absolute, darkness; upon them the rays of the absorbent photosphere fall; but these, not being sufficiently intense to make good the light intercepted, the spaces which they illuminate are dark, in comparison to the general brilliancy of the spectrum.—TYNDALL *Heat a Mode of Motion,* lect. 17, p. 512. (A., 1900.)

622. CONTAGION, SPREAD OF, AMONG SILKWORMS—*Care Necessary to Exclude Germs—One Infected Individual Will Poison Many.*—To protect the worms from contagion it is necessary to raise them at a distance from where infection has originated, in separate localities, perfectly adapted, that have been cleansed with the greatest care, and after all the apparatus has been most energetically washed to remove all the dust and débris of any preceding culture. And besides, it is necessary to take the most minute precautions not to introduce the germ of the malady into the room, especially no germ produced by a contemporaneous culture, since the contagion is infinitely more easy with the fresh dust than with that which is dry or old. Just one infected worm trailing its body and its dejecta over the leaves can poison a considerable number of healthy worms.—PASTEUR *Études sur la Maladie des Vers à Soie,* p. 64. (Translated for *Scientific Side-Lights.)*

623. CONTAMINATION, ARTIFICIAL—*Oysters Fattened on Sewage.*—It is four or five years since Professor Conn startled the medical world by tracing an epidemic of typhoid fever to the consumption of some uncooked oysters. Almost at the same time Sir William Broadbent published in the *British Medical Journal* a series of cases occurring in his practise which illustrated the same channel of infection. Since then a number of similar items of evidence to the same effect have cropped up. . . . The mode of infection of oysters by pathogenic bacteria is briefly as follows: The sewage of certain coast towns is passed untreated out to sea. At or near the outfall, oyster-beds are laid down for the purpose of fattening oysters. Thus they become contaminated with saprophytic and pathogenic germs contained in the sewage.—NEWMAN *Bacteria,* ch. 6, p. 229. (G. P. P., 1899.)

624. CONTEMPLATION, INVESTIGATION, EXPERIMENT—*The Three Stages in Knowledge of Phenomena.*—To the mere contemplation of Nature, to the observation of the phenomena accidentally presented to the eye in the terrestrial and celestial regions of space, succeeds investigation into the actual, an estimate by the measurement of magnitudes and the duration of motion. The earliest epoch of such a species of natural observation, altho principally limited to organic substances, was the age of Aristotle. There remains a third and higher stage in the progressive advancement of the knowledge of physical phenomena, which embraces an investigation into natural forces, and the powers by which these forces are enabled to act, in order to be able to bring the substances liberated into new combinations. The means by which this liberation is effected are experiments, by which phenomena may be called forth at will. The last-named stage of the process of knowledge, which was almost wholly disregarded in antiquity, was raised by the Arabs to a high degree of development.—HUMBOLDT *Cosmos,* vol. ii, pt. ii, p. 209. (H., 1897.)

625. CONTEMPLATION OF NATURE—*A Joy to Man—Its Silent Influence.*—In reflecting upon the different degrees of enjoyment presented to us in the contemplation of Nature, we find that the first place must be assigned to a sensation which is wholly independent of an intimate acquaintance with the physical phenomena presented to our view, or of the peculiar character of the region surrounding us. In the uniform plain bounded only by a distant horizon, where the lowly heather, the cistus, or waving grasses deck the soil; on the ocean shore, where the waves, softly rippling over the beach, leave a track, green with the weeds of the sea; everywhere, the mind is penetrated by the same sense of the grandeur and vast expanse of Nature, revealing to the soul, by a mysterious inspiration, the existence of laws that regulate the forces of the universe. Mere communion with Nature, mere contact with the free air, exercise a soothing yet strengthening influence on the wearied spirit, calm the storm of passion, and soften the heart when shaken by sorrow to its inmost depths. Everywhere, in every region of the globe, in every stage of intellectual culture, the same sources of enjoyment are alike vouchsafed to man.—HUMBOLDT *Cosmos,* vol. i, int., p. 25. (H., 1897.)

626. CONTEMPT OF SCHOLASTICS FOR SCIENCE—*Medieval Problems Concerned the Future World.*—The men of the Middle Ages, in fact, endeavored on the one hand to develop the laws of the universe a priori out of their own consciousness, while many of them were so occupied with the concerns of a future world that they looked with a lofty scorn on all things pertaining to this one. Speaking of the natural philosophers of his time, Eusebius says, "It is not through ignorance of the things admired by them, but through contempt of their useless labor, that we think little of these matters, turning our souls to the exercise of better things." So also Lactantius—"To search for the causes of things; to inquire whether the sun be as large as he seems; whether the moon is convex or concave; whether the stars are fixed in the sky, or float freely in the air; of

what size and of what material are the heavens; whether they be at rest or in motion; what is the magnitude of the earth; on what foundations is it suspended or balanced—to dispute and conjecture upon such matters is just as if we chose to discuss what we think of a city in a remote country, of which we never heard but the name."—TYNDALL *Lectures on Light,* lect. 1, p. 13. (A., 1898.)

627. CONTINENTS AND OCEANS PERSISTENT — *The Same General Formations from Geologic Times.*—We now know for certain that the sands and clays washed off the land—whether by the action of ice or river-waters on its surface, or by the wearing away of its margin by the waves of the sea—sink to the sea-bottom long before they reach the deeper abysses; not the least trace of such sediments having been anywhere found at a distance from the continental platforms. And thus the study of the deposits on the oceanic sea-bed has fully confirmed the conclusion drawn from the present configuration of the earth's surface, as to the general persistence of those original inequalities which have served as the bases of the existing continents, and the floors of the great ocean-basins.

In the masterly lecture on "Geographical Evolution," . . . given by Professor Geikie before the Royal Geographical Society, . . . he thus sums up:

"From all this evidence we may legitimately conclude that the present land of the globe, tho composed in great measure of marine formations, has never lain under the deep sea, but that its site must always have been near land. Even its thick marine limestones are the deposits of comparatively shallow water. Whether or not any trace of aboriginal land may now be discoverable, the characters of the most unequivocally marine formations bear emphatic testimony to the proximity of a terrestrial surface. The present continental ridges have probably always existed in some form; and as a corollary we may infer that the present deep ocean-basins likewise date from the remotest geological antiquity."—CARPENTER *Nature and Man,* lect. 11, p. 332. (A., 1889.)

628. CONTINENTS PERPETUALLY WASHED INTO THE SEA—The disintegrated materials, produced by chemical and mechanical actions of the atmospheric waters upon rock-masses, are by floods, rivers, and glaciers gradually transported from higher to lower levels; and sooner or later every fragment, when it has once been separated from a mountain-top, must reach the ocean, where these materials are accumulated and arranged to form new rocks.—JUDD *Volcanoes,* ch. 10, p. 284. (A., 1899.)

629. CONTINENTS, RELATIVE HEIGHT OF—*The "Sea-level" a Fluctuating Line.*—The existing land-surfaces of the globe are composed most frequently of marine strata. There are apparently only two ways in which this phenomenon can be accounted for, and these explanations come to much the same thing. Either the general level of the ocean has fallen, or wide areas of the sea-floor have been pushed up from below and converted into dry land. Both changes appear to have taken place. The bed of the sea has sunk from time to time to greater and greater depths, and has thus tended to draw the water away from the surface of what are now continental areas. But if the earth's crust under the ocean has subsided, it has also been elevated within what are now dry lands again and again.—GEIKIE *Earth Sculpture,* ch. 1, p. 12. (G. P. P., 1898.)

630. CONTINENTS SUBMERGED AT VARIOUS EPOCHS—*"The Earth Standing Out of the Water and in the Water."*—The extensive geographical range of the derivative rocks, most of which are of marine origin, must convince us that the greater portion of our continental areas has been under water. It is not to be understood, however, that all the land-surfaces occupied by sedimentary strata have been submerged at one and the same time. On the contrary, the several geological systems have been accumulated at widely different periods.—GEIKIE *Earth Sculpture,* ch. 1, p. 12. (G. P. P., 1898.)

631. CONTINUITY OF NATURE—*A Universe without Law, a Universe Deranged.*—Probably the most satisfactory way to secure for oneself a just appreciation of the principle of continuity is to try to conceive the universe without it. The opposit of a continuous universe would be a discontinuous universe, an incoherent and irrelevant universe—as irrelevant in all its ways of doing things as an irrelevant person. In effect, to withdraw continuity from the universe would be the same as to withdraw reason from an individual. The universe would run deranged.—DRUMMOND *Natural Law in the Spiritual World,* int., p. 34. (H. Al.)

632. CONTRACTION OF BULK MAY SUSTAIN HEAT OF SUN—*Gravity the Cause of Heat.*—If, now, there is no present manifestation of force sufficient to cover the expenditure of the sun's heat, the sun must originally have had a store of heat which it gradually gives out. But whence this store? We know that the cosmical forces alone could have produced it. And here the hypothesis, previously discussed as to the origin of the sun, comes to our aid. If the mass of the sun had been once diffused in cosmical space, and had then been condensed—that is, had fallen together under the influence of celestial gravity—if then the resultant motion had been destroyed by friction and impact, with the production of heat, the new world produced by such condensation must

have acquired a store of heat not only of considerable, but even of colossal, magnitude.—HELMHOLTZ *Popular Lectures,* lect. 4, p. 181. (L. G. & Co., 1898.)

633. ——— ——— *This Involves Final Extinction.*—In the very act of parting with heat, the sun develops a fresh stock. His radiations, in short, are the direct result of shrinkage through cooling. A diminution of the solar diameter by 380 feet yearly would just suffice to cover the present rate of emission, and would for ages remain imperceptible with our means of observation, since, after the lapse of 6,000 years, the lessening of angular size would scarcely amount to one second. But the process, tho not terminated, is strictly a terminable one. In less than five million years the sun will have contracted to half its present bulk. In seven million more, it will be as dense as the earth. It is difficult to believe that it will then be a luminous body. Nor can an unlimited past duration be admitted. Helmholtz considered that radiation might have gone on with its actual intensity for twenty-two, Langley allows only eighteen, million years. The period can scarcely be stretched, by the most generous allowances, to double the latter figure. But this is far from meeting the demands of geologists and biologists.—CLERKE *History of Astronomy,* pt. ii, ch. 9, p. 379. (Bl., 1893.)

634. CONTRADICTION, SEEMING, IN REFLECTION OF LIGHT—*White Light May Come from a Black Object.*—The light which falls upon a body is divided into two portions, one of which is reflected from the surface of the body; and this is of the same color as the incident light. If the incident light be white the superficially reflected light will also be white. Solar light, for example, reflected from the surface of even a black body, is white. The blackest camphine smoke in a dark room through which a sunbeam passes from an aperture in the window-shutter renders the track of the beam white, by the light scattered from the surfaces of the soot-particles. The moon appears to us as if

"Clothed in white samite, mystic, wonderful";

but were she covered with the blackest velvet she would still hang in the heavens as a white orb, shining upon our world substantially as she does now.—TYNDALL *Lectures on Light,* lect. 1, p. 33. (A., 1898.)

635. CONTRAST, IMPRESSIVE—*Forest and Steppe.*—From the rich luxuriance of organic life the astonished traveler [to the steppes of South America] suddenly finds himself on the dreary margin of a treeless waste. Nor hill nor cliff rears its head, like an island in the ocean, above the boundless plain: only here and there broken strata of floetz, extending over a surface of more than three thousand English square miles, appear sensibly higher than the surrounding district. The natives term them banks, as if the spirit of language would convey some record of that ancient condition of the world when these elevations formed the shoals, and the steppes themselves the bottom, of some vast inland sea.—HUMBOLDT *Views of Nature,* p. 1. (Bell, 1896.)

636. CONTRAST OF GIVING AND WITHHOLDING—*Mountain Lake with Flowing Stream—Bitter Waters with No Outlet.*—The waters of Lake Tahoe overflow through the Truckee cañon and form a bright, swift-flowing stream, which finds its way to Pyramid and Winnemucca lakes, situated 2,400 feet lower, in the desert valleys to the north. The waters when starting on their troubled journey are as pure and limpid as the melting snows of mountain valleys can furnish, . . . but the lakes into which they flow, and of which they form almost the sole supply, are alkaline and saline owing to long concentration. An example of an isolated drainage system is here furnished, embracing the cool summits of lofty mountains where the moisture of the atmosphere is condensed; a mountain reservoir where the waters are stored; a swift, clear stream formed by the overflow of the reservoir; and the bitter lakes where the stream empties and from which there is no escape except by evaporation.—RUSSELL *Lakes of North America,* ch. 4, p. 64. (G. & Co., 1895.)

637. CONTRAST OF HEAT AND COLD IN SOUTH AFRICA — *Solar Radiation — Wide Difference between Sunrise and Midday.*—Dr. Livingstone, in his "Travels in South Africa," has given some striking examples of the difference in nocturnal chilling when the air is dry and when it is laden with moisture. Thus he finds in South Central Africa during the month of June, "the thermometer early in the mornings at from 42° to 52°; at noon, 94° to 96°," or a mean difference of 48° between sunrise and midday. The range would probably have been found still greater had not the thermometer been placed in the shade of his tent, which was pitched under the thickest tree he could find. He adds, moreover, "the sensation of cold after the heat of the day was very keen. The Balonda at this season never leave their fires till nine or ten in the morning. As the cold was so great here, it was probably frosty at Linyanti; I therefore feared to expose my young trees there."—TYNDALL *Heat a Mode of Motion,* lect. 13, p. 387. (A., 1900.)

638. CONTRAST OF REFLECTED AND TRANSMITTED LIGHT—*Sunrise on Mt. Blanc.*—The sunrise from the summit [of Mt. Blanc] was singularly magnificent. The snow on the shaded flanks of the mountain was of a pure blue, being illuminated solely by the reflected light of the sky; the summit of the mountain, on the contrary,

was crimson, being illuminated by transmitted light. The contrast of both was finer than I can describe.—TYNDALL *Hours of Exercise in the Alps*, ch. 4, p. 57. (A., 1898.)

639. CONTRAST OF STORM-SWEPT MOUNTAIN AND SUNLIT VALLEY—*Pike's Peak in July—Waiting for Solar Eclipse under Difficulties.*—The snow entered [the tent] with the wind and lay in a deep drift on the pillow, when I woke after a brief sleep toward morning, and, looking out on the gray dawn, found that the snow had turned to hail, which was rattling sharply on the rocks with an accompaniment of thunder, which seemed to roll from all parts of the horizon. The snow lay thick, and the sheets of hail were like a wall, shutting out the sight of everything a few rods off, and this was in July [1878]! Hail, rain, sleet, snow, fog, and every form of bad weather continued for a week on the summit, while it was almost always clear below. It was often a remarkable sight to go to the edge and look down. The expanse of "the plains," which stretched eastward to a horizon line over a hundred miles distant, would be in bright sunshine beneath, while the hail was all around and above us; and the light coming up instead of down gave singular effects when the clouds parted below, the plains seeming at such times to be opalescent with luminous yellow and green, as tho the lower world were translucent and the sun were beneath it and shining up through.—LANGLEY *New Astronomy*, ch. 2, p. 54. (H. M. & Co.)

640. CONTRAST OF TEMPERATE AND TROPICAL VEGETATION—*Temperate Lands within the Tropics.*—The extraordinary height to which not only individual mountains but even whole districts rise in tropical regions, and the consequent cold of such elevations, affords the inhabitant of the tropics a singular spectacle. For besides his own palms and bananas, he is surrounded by those vegetable forms which would seem to belong solely to northern latitudes. Cypresses, pines, and oaks, barberry shrubs and alders (nearly allied to our own species), cover the mountain plains of southern Mexico and the chain of the Andes at the equator. Thus Nature has permitted the native of the torrid zone to behold all the vegetable forms of the earth without quitting his own clime, even as are revealed to him the luminous worlds which spangle the firmament from pole to pole.—HUMBOLDT *Views of Nature*, p. 231. (Bell, 1896.)

641. CONTRAST WITH ALL KNOWN EARTHLY CONDITIONS—*Endless Day and Endless Night on Mercury.*—And after long and patient watching, the conclusion was at last reached that Mercury turns on his axis in the same time needed to complete a revolution in his orbit. One of his hemispheres, then, is always averted from the sun, as one of the moon's hemispheres from the earth, while the other never shifts from beneath his torrid rays. The "librations," however, of Mercury are on a larger scale than those of the moon, because he travels in a more eccentric path. The temporary inequalities arising between his "even pacing" on an axis and his alternately accelerated and retarded elliptical movement occasion, in fact, an oscillation to and fro of the boundaries of light and darkness on his globe over an arc of 47° 22′, in the course of his year of 88 days. Thus the regions of perpetual day and perpetual night are separated by two segments, amounting to one-fourth of the entire surface, where the sun rises and sets once in 88 days. No variation from the fierce glare on one side of the globe and the nocturnal blackness on the other can, indeed, take place. Yet these apparently intolerable climatic conditions may be somewhat mitigated by the vigorous atmospheric circulation to which they would naturally give rise.—CLERKE *History of Astronomy*, pt. ii, ch. 7, p. 305. (Bl., 1893.)

642. CONTRASTS, MAN A CREATURE OF—*Physical Insignificance and Mental Supremacy*—"*What Is Man, that Thou Art Mindful of Him? . . . Thou Hast Made Him a Little Lower than the Angels*" (*Ps. viii, 3-5*).—It is, for instance, a strange and suggestive circumstance that man, insignificant in his dimensions and in all his physical powers, when viewed in comparison even with the earth on which he lives, and compelled to remain always upon that orb, which is utterly insignificant compared with the solar system, should yet dare to raise his thoughts beyond the earth and beyond the solar system, to contemplate boldly those amazing depths amidst which the stellar glories are strewn.

That he should undertake to measure the scale on which the universe is built, to rate the stars as with swift yet stately motion they career through space, to test and analyze their very substance, to form a judgment as to processes taking place upon and around them, tho not one star in all the heavens can be magnified into more than the merest point—all this affords noble conceptions of the qualities which the Almighty has implanted in the soul of man.—PROCTOR *Expanse of Heaven*, p. 104. (L. G. & Co.)

643. CONTRIVANCE FOR FERTILIZING ORCHID—*Bee Made to Carry Pollen from Flower to Flower.*—With most orchids the flowers remain open for some time before they are visited by insects: but with spiranthes I have generally found the boat-formed disks removed very soon after their expansion. For example, in the two last spikes which I happened to examine there were numerous buds on the summit of one, with only the seven lowest flowers expanded, of which six had their disks and pollinia removed: the other spike had eight expanded flowers, and the pollinia of all were removed.

When the flowers first open they would be attractive to insects, for the receptacle already contains nectar; and at this period the rostellum lies so close to the channeled labellum that a bee could not pass down its proboscis without touching the medial furrow of the rostellum. This I know to be the case by repeated trials with a bristle. We thus see how beautifully everything is contrived that the pollinia should be withdrawn by insects visiting the flowers. They are already attached to the disk by their threads, and, from the early withering of the anther-cells, they hang loosely suspended. . . . The touch of the proboscis causes the rostellum to split in front and behind, and frees the long, narrow, boat-formed disk, which is filled with extremely viscid matter, and is sure to adhere longitudinally to the proboscis. When the bee flies away, so surely will it carry away the pollinia.—DARWIN *Fertilization of Orchids*, ch. 4, p. 111. (A., 1898.)

644. CONTRIVANCE FOR SEED-DISPERSAL—*Burs of the Burdock—Animals as Distributers of Seeds.*—If you examine a burdock blossom you will find the lower part of the flower-head covered with green scales, each of which projects upward and outward, and at the tip curves over into a sharp-pointed hook, much the shape of a fish-hook. As the flower matures these hooks gradually become dry. Finally, when the seeds are ripe, the hooks are ready to catch hold of any animal that brushes against the plant. By this time the connection with the stem at the base of the flower-head has become sufficiently loosened so that the bur pulls off readily. Yet it holds on tight enough to remain attached to the plant through the winter, unless the grappling-hooks are taken hold of by some external agency. Consequently, the period during which the seeds are open to dissemination extends over many months. This, of course, is a decided advantage, for it greatly increases the chances that the seeds will be carried to other localities. When the bur becomes attached to the hair of an animal, it may be some time before it is removed. As it is rubbed by the creature or is brushed against trees or branches, it is likely to be pushed open, and the dozen or more seeds are likely, one by one, to drop to the ground. The individual seeds are rather large, in color brown mottled with black, and rather smooth except for a few slightly projecting, longitudinal ridges.—WEED *Seed-travelers*, pt. iii, p. 49. (G. & Co., 1899.)

645. ———— ———— *Seeds Shot as from Thumb and Finger.*—The witch-hazel bears a hard, woody, nutlike fruit, as large as a hazelnut; when ripe, the apex gapes open more and more, the sides pressing harder against each smooth seed, till finally it is shot, sometimes for a distance of thirty feet. —BEAL *Seed Dispersal*, ch. 6, p. 60. (G. & Co., 1898.)

646. CONTRIVANCE IN NATURE—*Beauty and Completeness of Adaptation Exceed Imagination.*—The more I study Nature, the more I become impressed with ever-increasing force that the contrivances and beautiful adaptations slowly acquired through each part, occasionally varying in a slight degree, but in many ways, with the preservation of those variations which were beneficial to the organism under complex and ever-varying conditions of life, transcend in an incomparable manner the contrivances and adaptations which the most fertile imagination of man could invent.—DARWIN *Fertilization of Orchids*, ch. 9, p. 285. (A., 1898.)

647. CONTRIVANCE NOT UNWORTHY OF THE SUPREME WILL—This idea of the relation in which law stands to will, and in which will stands to law, is familiar to us in the works of man; but it is less familiar to us as equally holding good in the works of Nature. We feel, sometimes, as if it were an unworthy notion of the will which works in Nature, to suppose that it should never act except through the use of means. But our notions of unworthiness are themselves often the unworthiest of all. They must be ruled and disciplined by observation of that which is—not founded on a priori conceptions of what ought to be. Nothing is more certain than that the whole order of Nature is one vast system of contrivance. And what is contrivance but that kind of arrangement by which the unchangeable demands of law are met and satisfied? —ARGYLL *Reign of Law*, ch. 3, p. 76. (Burt.)

648. CONTROVERSY BETWEEN HOLDERS OF PARTIAL TRUTHS—*Geologic Theories of Formation of Rocks by Fire and by Water.*—There were many well-fought battles between geologists before it was understood that these two elements [fire and water] had been equally active in building up the crust of the earth. The ground was hotly contested by the disciples of the two geological schools, one of which held that the solid envelope of the earth was exclusively due to the influence of fire, while the other insisted that it had been accumulated wholly under the agency of water. This difference of opinion grew up very naturally; for the great leaders of the two schools lived in different localities, and pursued their investigations over regions where the geological phenomena were of an entirely opposite character—the one exhibiting the effect of volcanic eruptions, the other that of stratified deposits. It was the old story of the two knights on opposite sides of the shield.—AGASSIZ *Geological Sketches*, ser. i, ch. 1, p. 6. (H. M. & Co., 1896.)

649. CONTROVERSY OVER LITTLE HILL—*Rival Schools of Cosmogony.*—Near the highroad which passes between the towns of Eger and Franzenbad in Bohemia,

there rises a small hill known as the Kammerbühl, which has attracted to itself an amount of interest and attention quite out of proportion to its magnitude or importance. During the latter part of the last century and the earlier years of the present one, the fiercest controversies were waged between the partisans of rival schools of cosmogony over this insignificant hill, some maintaining that it originated in the combustion of a bed of coal, others that its materials were entirely formed by some kind of "aqueous precipitation," and others again that the hill was the relic of a small volcanic cone. Among those who took a very active part in this controversy was the poet Goethe, who stoutly maintained the volcanic origin of the Kammerbühl, styling it "a pocket edition of a volcano" [which the excavations undertaken at his instance have proved it to be].—JUDD *Volcanoes*, ch. 5, p. 112. (A., 1899.)

650. CONVERGENCE OF SCIENCES UPON EVOLUTION—*Authority in Agreement.*—The hypothesis of evolution must be ultimately either established or disproved by its accordance or disaccordance with a vast aggregate of facts of Nature which belong to different departments of scientific inquiry. The geologist traces the succession of plants and animals in paleontological order, and finds, as he advances in his studies, less and less evidence of interruption, and more and more of continuity, biological as well as physical. The zoologist and botanist, who have been accustomed to classify their multitudinous and diversified forms of plants and animals according to their "natural affinities," find a real meaning in their classification, a new significance in their terms of relationship, when these are used to represent what might be regarded with probability as actual community of descent. The morphologist who has been accustomed to trace a "unity of type" in each great group, and especially to recognize this in the presence of rudimentary parts which must be entirely useless to the animals that possess them, delights in the new idea which gives a perfect rationale of what had previously seemed an inexplicable superfluity. And the embryologist, who carries back his studies to the earliest phases of development, and follows out the grand law of Von Baer, "from the general to the special," in the evolution of every separate type, finds the extension of that law from the individual to the whole succession of organic life impart to his soul a feeling of grandeur like that which the physical philosopher of two hundred years ago must have experienced when Newton first promulgated the doctrine of universal gravitation. And lastly, when the doctrine of evolution is looked at in its moral aspect, as one which leads man ever onwards and upwards, and which encourages his brightest anticipations of the ultimate triumph of truth over error, of knowledge over ignorance, of right over wrong, of good over evil, who shall presume to say that the convergence of all these great lines of thought, each of them the resultant of the patient toil of a whole army of scientific workers, is a fact of no account?—CARPENTER *Nature and Man*, lect. 7, p. 237. (A., 1889.)

651. CONVOLUTIONS DETERMINE SURFACE AND POWER OF BRAIN—*An Invisible Engraving in Bodily Substance Wrought by All Great Souls.*—Increase of the cerebral surface is shown not only in the general size of the organ, but to a still greater extent in the irregular creasing and furrowing of the surface. This creasing and furrowing begins to occur in the higher mammals, and in civilized man it is carried to an astonishing extent. The amount of intelligence is correlated with the number, the depth, and the irregularity of the furrows. A cat's brain has a few symmetrical creases. In an ape the creases are deepened into slight furrows, and they run irregularly, somewhat like the lines in the palm of your hand. With age and experience the furrows grow deeper and more sinuous, and new ones appear; and in man these phenomena come to have great significance. The cerebral surface of a human infant is like that of an ape. In an adult savage, or in a European peasant, the furrowing is somewhat marked and complicated. In the brain of a great scholar the furrows are very deep and crooked, and hundreds of creases appear which are not found at all in the brains of ordinary men. In other words, the cerebral surface of such a man, the seat of conscious mental life, has become enormously enlarged in area; and we must further observe that it goes on enlarging in some cases into extreme old age.—FISKE *Destiny of Man*, ch. 5, p. 48. (H. M. & Co., 1900.)

652. COOKERY AMONG PRIMITIVE WOMEN—*Cassava Griddle-cakes.*—The cooking is done after the following fashion: A large flat slab of stone is placed over a fire, and on this griddle a thin layer of meal is spread. A woman, fan in hand, sits by the fire watching. With her fan she smooths the upper surface of the cake and makes its edges round. In a few minutes one side is done, and when the cake is turned it is done in two minutes more. They are next thrown on the roof to dry, and I have often vainly tried to imitate the skill with which an Indian woman "quoits" up one of these large and thin cakes on to the roof, often high above her head. When thoroughly dried the bread is hard and crisp.—MASON *Woman's Share in Primitive Culture*, ch. 2, p. 39. (A., 1894.)

653. COOKERY, IMPORTANCE OF—*More Depends on the Cook than on the Materials Cooked—The Quality of a Soup.*—His [Benjamin Thompson's] faith in cook-

ery is well expressed in the following, where he is speaking of his experiments in feeding the Bavarian army and the poor of Munich. He says: "I constantly found that the richness or quality of a soup depended more upon the proper choice of the ingredients, and a proper management of the fire in the combination of these ingredients, than upon the quantity of solid nutritious matter employed; much more upon the art and skill of the cook than upon the sums laid out in the market."—WILLIAMS *Chemistry of Cookery,* ch. 1, p. 5. (A., 1900.)

654. COOKING, EARLY DEVICES FOR—*Boiling by Hot Stones—No Boiled Meats in Homeric Feasts—Found in Northmen's Traditions.*—In many parts of the world, among tribes who do not know how to make an earthen pot, there is found the curious art of stone-boiling, which is a sort of wet baking. The Assiniboins of North America have their name, which means "stone-boilers," from their old practise of digging a hole in the ground, lining it with a piece of the slaughtered animal's hide, and then putting in the meat with water, and hot stones to boil it. Tribes of the far West actually managed by means of red-hot stones to boil salmon and acorn-porridge in their baskets made of close-plaited roots of the spruce-fir. The process of stone-boiling has lasted on even in Europe where found convenient for heating water in wooden tubs. Linnæus on his northern tour found the Bothland people brewing beer in this way, and to this day the "rude Carinthian boor" drinks such "stone-beer," as it is called. As soon as the cooks anywhere are provided with earthen pots or metal kettles, boiling over the fire becomes easy. Yet it is curious to notice the absence of boiled meats from the feasts of the Homeric heroes, where there is so much about the joints stuck on spits to roast, and the vengeful Odysseus rolling to and fro on his bed is compared to an eager roaster turning a stuffed paunch before the blazing fire. Among the old Northmen it was otherwise, for it is told in the Edda how the warriors feast every night in Valhalla on the sodden flesh of the boar Sæhrimner, who is daily boiled in the huge kettle, and comes to life again ready for the morrow's hunt.—TYLOR *Anthropology,* ch. 11, p. 266. (A., 1899.)

655. COOKING, SCIENTIFIC VALUE OF — *Destroys Most Bacteria.* — Injurious micro-organisms in foods are, fortunately for the consumers, usually killed by cooking. Vast numbers are, as far as we know, of no harm whatever. Alarming reports of the large numbers of bacteria which are contained in this or that food are generally as irrelevant as they are incorrect. Bacteria, as we have seen, are ubiquitous. In food we have abundance of the chief thing necessary to their life and multiplication—favorable nutriment. Hence we should expect to find, in uncooked or stale food an ample supply of saprophytic bacteria. There was much wholesome truth in the assertions made some two years ago by the late Professor Kanthack, to the effect that good food as well as bad frequently contained large numbers of bacteria, and often of the same species. It is well that we should become familiarized with this idea, for its accuracy cannot be doubted, and its usefulness at the present time may not be without its beneficial effect.—NEWMAN *Bacteria,* ch. 5, p. 178. (G. P. P., 1899.)

656. COOKING THE INVENTION OF WOMAN—There are in many lands plants which in the natural state are poisonous or extremely acrid or pungent. The women of these lands have all discovered independently that boiling or heating drives off the poisonous or disagreeable element. The Indians of southern California gather the leaves and stems of several cruciferous plants, throw them into hot water, then rinse them out in cold water five or six times, then dry them and use them as boiled cabbage. This washing removes the bitter taste and certain substances which are likely to produce nausea and diarrhea. The removal of poisonous matter from tapioca by means of hot water is the discovery of savage women.—MASON *Woman's Share in Primitive Culture,* ch. 2, p. 24. (A., 1894.)

657. COOPERATION AMONG BRUTES, UNSUPPORTED STORIES OF—*Thresher and Swordfish—Pilot-fish and Shark—Blind Instinct of Remora.*—Dr. Günther, however, denies that the thresher ever attacks whales; and Professor Moseley writes me that he considers the alleged cases "very unlikely," as the hide of the whale is so tough, and the blubber so thick, that the animal would not "feel or care about the thresher, which, by falling on the whale from a height of say 20 feet, might nearly commit suicide without the whale knowing anything about it." Moreover, as regards the pilot-fish, Professor Moseley writes me that from actual observation he can fully corroborate the opinion which I have expressed. "The pilot-fish," he says, "cannot possibly hold on the shark, as it has no means of attachment"; "it is the remora (which habitually clings to the bodies of sharks) that has been mistaken for the pilot-fish. The latter is a most unfortunate fish to run as exhibiting animal intelligence. It constantly mistakes a ship for a big shark, swimming for weeks near the water-surface, just a foot in front of the cutwater. Now, if it swam just behind the stern it would get plenty of food, whereas in front of the bow it gets nothing whatever. Nevertheless, it stays on at what in a shark is of course the right place, ready to be at the beast's mouth directly food is found." [1886.]—ROMANES *Animal Intelligence,* ch. 8, p. 253. (A., 1899.)

658. COOPERATION DEPENDS UPON COMMUNICATION—*A Nervous System Quarter of a Mile Long—The Most Perfect Signal-service Triumphs.*—The success of he cooperative principle, however, depends pon one condition: the members of the erd must be able to communicate with one nother. It matters not how acute the enses of each animal may be, the strength f the column depends on the power to ransmit from one to another what impressions each may receive at any moment from vithout. Without this power the sociality f the herd is stultified; the army, having o signaling department, is powerless as an rmy. But if any member of the herd is ble by motion of head or foot or neck or ar, by any sign or by any sound, to pass on he news that there is danger near, each intantly enters into possession of the faculies of the whole. Each has a hundred eyes, oses, ears. Each has a quarter of a mile of erves. Thus numbers are strength only vhen strength is coupled with some power f intercommunication by signs. If one herd levelops this signaling system and another loes not, its chances of survival will be reater. The less equipped herds will be lowly decimated and driven to the wall; nd those which survive to propagate their ind will be those whose signal-service is nost efficient and complete.—DRUMMOND *Ascent of Man*, p. 156. (J. P., 1900.)

659. COOPERATION IN LOWER LIFE—*A Colonial Animal—Animal Resembling Plant.*—Let us pick up a piece of this "seaweed" and note its structure. You observe it resembles a fir-tree in miniature. Its total length is about four inches, and ou note that it grows rooted and fixed like ny plant on oyster-shells and other objects. Little wonder that it is called a sea-plant, or its habits and its appearance certainly end support to that view of its nature. Scan its structure, however, a little more closely by aid of this lens, and you observe hat in place of leaves or flowers the branches bear hundreds of little cups set in each side. . . . Then your gaze alights on a curious sight. You find that each of these cups or cells is tenanted by a living animal. . . .

Our sea-fir is a compound or colonial animal, which numbers its members by the hundred. It is something more, however. It appears before us as a typical example of a cooperative society. For the colony is nourished, not by the labor of one, but by the work of all its members. Each little animal unit captures food and digests it, and then delivers this nutriment over to the general store or common fund, which is circulating always through the hollow stem and branches of the colony. From this common store each unit in turn draws its own supply.

There is perfect cooperation witnessed here. No wrangling and quarreling, such as intervene in higher societies, exist. Lower life knows nothing of the overweening ambition of the twos or threes over the aims of the mass. There is no question or claim of precedence in the sea-fir democracy. All is harmony, equality, fraternity here; and the currents of sea-fir life roll onwards undisturbed by the passions of higher existence.—ANDREW WILSON *Glimpses of Nature*, ch. 9, p. 33. (Hum., 1892.)

660. COOPERATION, UNCONSCIOUS—*Flowers and Insects—Color and Fragrance Attract for a Purpose—Life Dependent on Beauty and Sweetness.*—The vegetable world is a world of still life. No higher plant has the power to move to help its neighbor, or even to help itself, at the most critical moment of its life. . . . The fertilizing pollen grows on one part of the flower, the stigma which is to receive it grows on another, or it may be on a different plant. But as these parts cannot move towards one another, the flower calls in the aid of moving things. . . . Multitudes of flowers without such aid could never seed at all. It is to these cooperations that we owe all that is beautiful and fragrant in the flower world. To attract the insect and recompense it for its trouble, a banquet of honey is spread in the heart of the flower; and to enable the visitor to find the nectar, the leaves of the flower are made showy or conspicuous beyond all other leaves. To meet the case of insects which love the dusk, many flowers are colored white; for those which move about at night and cannot see at all, the night-flowers load the darkness with their sweet perfume. The loveliness, the variegations of shade and tint, the ornamentations, the scents, the shapes, the sizes of flowers, are all the gifts of cooperation. The flower in every detail, in fact, is a monument to the cooperative principle.—DRUMMOND *Ascent of Man*, p. 234. (J. P., 1900.)

661. COORDINATION OF BODILY ACTIVITIES—*Stronger Excitement Arouses a Greater Number—Unity of the Body.*—My hand is lying quiescent on the table; something touches it lightly, a fly, or a feather: there is a rush of activity to certain muscles, and the hand is moved away. Well, supposing the two things to be remote cause and effect: the light contact—cause, the motion—effect: what may we suppose as to the intermediate links? Unless the process be something quite unique, there must be a channel of communication between the skin of the hand and the group of muscles in the shoulder, upper arm, and forearm, that unite to withdraw the hand. Assuming the concurrence of ten muscles, there must be a ramifying thread of communication from any point in the skin of the hand to all those ten muscles. . . .

Suppose now, instead of a light contact, the hand is sharply pinched in the very same place. . . . [Now] with the mere

arm movements are coupled a great many more—in the other arm, the legs, the body, and the face, besides the more concealed movements shown in the voice, which emits a cry, shout, or other exclamation. We see that any part of the skin of the hand is in connection with perhaps two hundred muscles, the notable circumstance being that a weak touch does not arouse the wider circle of movements. . . . A very bitter taste, a malodor, a screeching discord, an intense flame, will each awaken movements of limbs, body, face, and voice. Every one of the senses is in the same extensive communication with the organs of motion.—BAIN *Mind and Body*, ch. 3, p. 6. (Hum., 1880.)

662. COPPER HAMMERED INTO SHAPE—*Indians Ignorant of Casting.*—It has often been stated that the Indians possessed some method, at present unknown, by which they were enabled to harden the copper. This, however, seems to be an error. Some copper implements, which Mr. Wilson submitted to Professor Crofts, were found to be no harder than the native copper from Lake Superior. "The structure of the metal was also highly laminated, as if the instrument had been brought to its present shape by hammering out a solid mass of copper."—AVEBURY *Prehistoric Times*, ch. 8, p. 242. (A., 1900.)

663. CORAL ANIMALS FOUND BELOW THIRTY FATHOMS—*No Reefs at the Greater Depth.*—Until quite recently it was usually stated in works dealing with the structures of coral reefs that the so-called reef-building corals, that is to say the large madrepores, astræids, and others, are confined to water not deeper than thirty fathoms. This limit must now be somewhat extended, in consequence of the discovery by Captain Moore of an abundance of growing coral at a depth of forty-four fathoms in the China seas: but, nevertheless, it is perfectly true that the corals do not grow in such profusion in very deep water as to form anything that can be compared with the reefs of the shores. It is quite possible that the advantages afforded by the light, warmth, and abundance of food of the shallow water may account for the luxuriance and vigor of the reef corals, and that where the food is scarce, and the water cold and dark, as it is below fifty fathoms, the power of continuous gemmation is lost, and the rapidity of the growth and reproduction of the individual polyps is considerably diminished.—HICKSON *Fauna of the Deep Sea*, ch. 5, p. 94. (A., 1894.)

664. CORONA OF THE SUN—*Seen Only when Eclipse Abolishes the Glare.*—Owing to the scattering of light by matter floating mechanically in the earth's atmosphere, the sun is seen not sharply defined, but surrounded by a luminous glare. Now, a loud noise will drown a whisper, an intense light will quench a feeble one, and so this circumsolar glare prevents us from seeing many striking appearances round the border of the sun. The glare is abolished in total eclipses, when the moon comes between the earth and the sun, and there are then seen a series of rose-colored protuberances, stretching sometimes tens of thousands of miles beyond the dark edge of the moon. They are described by Vassenius in the "Philosophical Transactions" for 1733, and were probably observed even earlier than this. In 1842 they attracted great attention, and were then compared to Alpine snow-peaks reddened by the evening sun. That these prominences are flaming gas, and principally hydrogen gas, was first proved by M. Janssen during an eclipse observed in India, on the 18th of August, 1868.—TYNDALL *Lectures on Light*, lect. 6, p. 206. (A., 1898.)

665. ——— ——— *Stedfast Glory of Evanescent Substance.*—This outer envelope [of the sun], tho gaseous in the main, is not spherical, but has an outline exceedingly irregular and variable. It seems to be made up not of overlying strata of different density, but rather of flames, beams, and streamers, as transient and unstable as those of our own aurora borealis. It is divided into two portions, separated by a boundary as definite, tho not so regular, as that which parts them both from the photosphere. The outer and far more extensive portion, which in texture and rarity seems to resemble the tails of comets, and may almost, without exaggeration, be likened to "the stuff that dreams are made of," is known as the "coronal atmosphere," since to it is chiefly due the "corona" or glory which surrounds the darkened sun during an eclipse, and constitutes the most impressive feature of the occasion.—YOUNG *The Sun*, ch. 6, p. 191. (A., 1898.)

666. CORRECTION OF IMPRESSIONS—*A Characteristic of Normal Mental Life.*—Finally, it should never be forgotten that in normal states of mind there is always the possibility of rectifying an illusion. What distinguishes abnormal from normal mental life is the persistent occupation of the mind by certain ideas, so that there is no room for the salutary corrective effect of reflection on the actual impression of the moment, by which we are wont to "orientate," or take our bearings as to the position of things about us. In sleep, and in certain artificially produced states, much the same thing presents itself. Images become realities just because they are not instantly recognized as such by a reference to the actual surroundings of the moment. But in normal waking life this power of correction remains with us. We may not exercise it, it is true, and thus the illusion will tend to become more or less persistent and recurring; for the same law applies to true and to false perception: repetition makes the process easier. But if we only

choose to exert ourselves, we can always keep our illusions in a nascent or imperfectly developed stage.—SULLY *Illusions*, ch. 6, p. 124. (A., 1897.)

667. CORRELATION OF GROWTH —*The Law of Symmetry—Plants, Animals, and Crystals Symmetrical.*—One relation which we detect in all variations of organic growth is simply the relation of symmetry. This kind and degree of correlation of growth prevails even in the world which we call inorganic. The corresponding sides and angles of a crystal, for example, may be said to be correlated together. The nature of this relation is geometrical and numerical. It is a relation having reference to invariable rules of number. As regards its physical cause, all we can say is that it is the result of forces whose property it is to aggregate the particles of matter in definite forms, which forms are symmetrical—that is to say, they are forms having an axis with equal developments on either side. Correlation of growth, therefore, in this sense points to the work of forces, one of whose essential properties is polarity—that is, equal and similar action in opposite directions. Now, this kind of correlation of growth may be traced upwards from simple minerals through all the infinite complications of the organic world. It is unquestionably the basis of many of the correlations of growth prevailing in plants and animals. It is seen in the symmetrical arrangement of all vegetable and of all animal forms. A central axis is traceable in them all, and the bilateral or radiated arrangement of their subordinate parts is one of the most fundamental and universal of all the correlations of growth.—ARGYLL *Reign of Law*, ch. 5, p. 144. (Burt.)

668. CORRELATION OF SCIENCES —*Chemistry and Microscopy Aid Each Other.*—It should always be remembered that a chemical report and a bacteriological report should assist each other. The former is able to tell us the quantity of salts and condition of the organic matter present; the latter the number and quality of micro-organisms. Neither can take the place of the other, and, generally speaking, both are more or less useless until we can learn, by inspection and investigation of the source of the water, the origin of the organic matter or contamination. Hence a water report should contain not only a record of physical characters, of chemical constituents, and of the presence or absence of micro-organisms, injurious and otherwise, but it should also contain information obtained by personal investigation of the source. Only thus can a reasonable opinion be expected.—NEWMAN *Bacteria*, ch. 2, p. 51. (G. P. P., 1899.)

669. CORRESPONDENCE BETWEEN EMBRYOLOGY AND GEOLOGY FAILS IN PARTICULARS—When we rigorously compare the development of any animal whatever with the successive appearance of animals of the same or similar groups in geological time, we find many things which do not correspond—not merely in the want of links which we might expect to find, but in the more significant appearance, prematurely or inopportunely, of forms which we would not anticipate.—DAWSON *Facts and Fancies in Modern Science*, lect. 1, p. 66. (A. B. P. S.)

670. CORRESPONDENCE BETWEEN PITCH OF SOUND AND COLOR—*Inconceivable Number of Light-waves.*—The pitch of sound is wholly determined by the rapidity of the vibration, as the intensity is by the amplitude. What pitch is to the ear in acoustics, color is to the eye in the undulatory theory of light. Tho never seen, the lengths of the waves of light have been determined. Their existence is proved by their effects, and from their effects also their lengths may be accurately deduced. This may, moreover, be done in many ways, and, when the different determinations are compared, the strictest harmony is found to exist between them. This consensus of evidence is one of the strongest points of the undulatory theory. The shortest waves of the visible spectrum are those of the extreme violet; the longest, those of the extreme red; while the other colors are of intermediate pitch or wavelength. The length of a wave of the extreme red is such that it would require 36,918 of them, placed end to end, to cover one inch, while 64,631 of the extreme violet waves would be required to span the same distance. Now, the velocity of light, in round numbers, is 190,000 [186,414, Flammarion, "Popular Astronomy," p. 318] miles per second. Reducing this to inches, and multiplying the number thus found by 36,918, we find the number of waves of the extreme red, in 190,000 miles, to be four hundred and fifty-one millions of millions. All these waves enter the eye, and strike the retina at the back of the eye in one second. In a similar manner, it may be found that the number of shocks corresponding to the impression of violet is seven hundred and eighty-nine millions of millions.—TYNDALL *Lectures on Light*, lect. 2, p. 62. (A., 1898.)

671. CORRESPONDENCE DEMANDS A PLAN—*The Natural Includes the Supernatural.*—Here the supermaterial, and in this sense the supernatural, element—that is to say, the ideal conformity and unity of conception—is the one unquestionable fact in which we recognize directly the working of a mind with which our own has very near relations. Here, as elsewhere, we see the natural, in the largest sense, including and embodying the supernatural; the material, including the supermaterial. No possible theory, whether true or false, in respect to the physical means employed to preserve the correspondence of parts which runs through all creation, can affect the certainty of that

mental plan and purpose which alone makes such correspondence intelligible to us, and in which alone it may be said to exist.—ARGYLL *Reign of Law*, ch. 1, p. 19. (Burt.)

672. CORRESPONDENCE OF ANIMAL ORGANS—*Likeness Found Only in an Order of Thought.*—An order so vast as this, including within itself such variety of detail, and maintained through such periods of time, implies combination and adjustment founded upon, and carrying into effect, one vast conception. It is only as an order of thought that the doctrine of animal homologies is intelligible at all. It is a mental order, and can only be mentally perceived. For what do we mean when we say that this bone in one kind of animal corresponds to such another bone in another kind of animal? Corresponds—in what sense? Not in the method of using it—for very often limbs which are homologically the same are put to the most diverse and opposite uses. To what standard, then, are we referring when we say that such and such two limbs are homologically the same? It is to the standard of an ideal order—a plan—a type—a pattern mentally conceived. This sounds very recondite and metaphysical; and yet the habit of referring physical facts to some ideal standard and order of thought is a universal instinct in the human mind. It is one of the earliest of our efforts in endeavoring to understand the phenomena around us.—ARGYLL *Reign of Law*, ch. 4, p. 117. (Burt.)

673. COSMOGONY OF DANTE WRECKED BY COPERNICAN ASTRONOMY—*Men Thought Christianity Threatened.*—With the advent of the Copernican astronomy the funnel-shaped inferno, the steep mountain of purgatory crowned with its terrestrial paradise, and those concentric spheres of heaven wherein beatified saints held weird and subtle converse, all went their way to the limbo prepared for the childlike fancies of untaught minds, whither Hades and Valhalla had gone before them. In our day it is hard to realize the startling effect of the discovery that man does not dwell at the center of things, but is the denizen of an obscure and tiny speck of cosmical matter quite invisible amid the innumerable throng of flaming suns that make up our galaxy. To the contemporaries of Copernicus the new theory seemed to strike at the very foundations of Christian theology.—FISKE *Destiny of Man*, ch. 1, p. 15. (H. M. & Co., 1900.)

674. COSMOGONY, ORIENTAL—*Hindu Account of Creation—Ordinances of Menû.*—The earliest doctrines of the Indian and Egyptian schools of philosophy agreed in ascribing the first creation of the world to an omnipotent and infinite being. They concurred also in representing this being, who had existed from all eternity, as having repeatedly destroyed and reproduced the world and all its inhabitants. In the sacred volume of the Hindus, called the "Ordinances of Menû," comprising the Indian system of duties religious and civil, we find a preliminary chapter treating of the creation, in which the cosmogony is known to have been derived from earlier writings and traditions, and principally from certain hymns of high antiquity, called the Vedas. These hymns were first put together, according to Mr. Colebrooke, in a connected series, about thirteen centuries before the Christian era, but they appear from internal evidence to have been written at various antecedent periods. In them, as we learn from the researches of Professor Wilson, the eminent Sanskrit scholar, two distinct philosophical systems are discoverable. According to one of them, all things were originally brought into existence by the sole will of a single first cause, which existed from eternity; according to the other, there have always existed two principles, the one material, but without form, the other spiritual and capable of compelling "inert matter to develop its sensible properties." This development of matter into "individual and visible existences" is called creation, and is assigned to a subordinate agent, or the creative faculty of the Supreme Being embodied in the person of Brahma.—LYELL *Principles of Geology*, bk. i, ch. 2, p. 4. (A., 1854.)

675. COST OF PLEASURE AND PAIN—*Expenditure of Blood and Nerve-tissue—Waste of Life-force by Stimulants.*—Every throb of pleasure costs something to the physical system; and two throbs cost twice as much as one. If we cannot fix a precise equivalent, it is not because the relation is not definite, but from the difficulties of reducing degrees of pleasure to a recognized standard. Of this, however, there can be no reasonable doubt—namely, that a large amount of pleasure supposes a corresponding large expenditure of blood and nerve-tissue, to the stinting, perhaps, of the active energies and the intellectual processes. It is a matter of practical moment to ascertain what pleasures cost least, for there are thrifty and unthrifty modes of spending our brain and heart's blood. Experience probably justifies us in saying that the narcotic stimulants are, in general, a more extravagant expenditure than the stimulation of food, society, and fine art. One of the safest of delights, if not very acute, is the delight of abounding physical vigor; for, from the very supposition, the supply to the brain is not such as to interfere with the general interests of the system. But the theory of pleasure is incomplete without the theory of pain.

As a rule, pain is a more costly experience than pleasure, altho sometimes economical as a check to the spendthrift pleasures. Pain is physically accompanied by an excess of blood in the brain, from at least two causes—extreme intensity of nervous action

and conflicting currents, both being sources of waste. . . . The ideally best condition is a moderate surplus of pleasure—a gentle glow, not rising into brilliancy or intensity, except at considerable intervals (say a small portion of every day), falling down frequently to indifference, but seldom sinking into pain.—BAIN app. to *Conservation of Energy*, by STEWART, p. 429. (Hum., 1880.)

676. COSTUME CHANGED WITH SEASON—*Mystery of Color among Birds.*—Quite apart from the changes in color due to age, a bird may throughout its life change costumes with the seasons. Thus, the male bobolink, after the nesting season, exchanges his black, white, and buff nuptial suit for a sparrowlike dress resembling that of his mate. The scarlet tanager sheds his gay body plumage and puts on the olive-green colors of the female, without changing, however, the color of his black wings and tail. The following spring both birds resume the more conspicuous coats. A more or less similar change takes place among many birds in which the male is brighter than the female, but, among land birds, when the adults of both sexes are alike, there is little or no seasonal change in color.—CHAPMAN *Bird-Life*, ch. 3, p. 37. (A., 1900.)

677. COUNTING, METHODS OF, AMONG SAVAGES—Even the comparatively intellectual Zulus can only count up to ten by using the hands and fingers. The Ahts of Northwest America count in nearly the same manner, and most of the tribes of South America are no further advanced. Somewhat higher races, as the Eskimos, can count up to twenty by using the hands and the feet; and other races get even further than this by saying "one man" for twenty, "two men" for forty, and so on, equivalent to our rural mode of reckoning by scores.—WALLACE *Darwinism*, ch. 15, p. 312. (Hum.)

678. COURAGE AND RESOLUTION OF SCIENTIST—*Gorge Cut by River Explored.*—This year I subjected the famous Finsteraarschlucht to a closer examination than ordinary. The earthquake theory already adverted to was prevalent regarding it, and I wished to see whether any evidences existed of aqueous erosion. It will be remembered that the Schlucht or gorge is cut through a great barrier of limestone rock called the Kirchet, which throws itself across the valley of Hasli, about three-quarters of an hour's walk above Meyringen. . . . It was regarding the sides of the great chasm that I needed instruction, and from its edge I could see nothing to satisfy me. I therefore stripped and waded into the river until a point was reached which commanded an excellent view of both sides of the gorge. The water was cutting, but I was repaid. Below me on the left-hand side was a jutting cliff, which bore the thrust of the river and caused the Aar to swerve from its direct course. From top to bottom this cliff was polished, rounded, and scooped. There was no room for doubt. The river which now runs so deeply down had once been above. It has been the delver of its own channel through the barrier of the Kirchet.—TYNDALL *Hours of Exercise in the Alps*, ch. 22, p. 256. (A., 1898.)

679. COURTSHIP AN EDUCATIONAL SEASON—*Giving Love Time for Development.*—Courtship, with its vivid perceptions and quickened emotions, is a great opportunity for evolution; and to institute and lengthen reasonably a period so rich in impression is one of its latest and highest efforts. To give love time, indeed, has been all along, and through a great variety of arrangements, the chief means of establishing it on the earth.—DRUMMOND *Ascent of Man*, p. 304. (J. P., 1900.)

680. CRAMMING SCIENTIFICALLY BAD—*Hasty Learning Opens Few Lines of Association—Oblivion a Sure Result.*—The reason why cramming is such a bad mode of study is now made clear. I mean by cramming that way of preparing for examinations by committing "points" to memory during a few hours or days of intense application immediately preceding the final ordeal, little or no work having been performed during the previous course of the term. Things learned thus in a few hours, on one occasion, for one purpose, cannot possibly have formed many associations with other things in the mind. Their brain-processes are led into by few paths, and are relatively little liable to be awakened again. Speedy oblivion is the almost inevitable fate of all that is committed to memory in this simple way. Whereas, on the contrary, the same materials taken in gradually, day after day, recurring in different contexts, considered in various relations, associated with other external incidents, and repeatedly reflected on, grow into such a system, form such connections with the rest of the mind's fabric, lie open to so many paths of approach, that they remain permanent possessions. This is the intellectual reason why habits of continuous application should be enforced in educational establishments.—JAMES *Psychology*, vol. i, ch. 16, p. 663. (H. H. & Co., 1899.)

681. CREATION A COMING-TO-BE—*Creative Power May Use Preexisting Material—"The Dust of the Ground."*—I do not know on what authority it is that we so often speak as if creation were not creation unless it work from nothing as its material, and by nothing as its means. We know that out of the "dust of the ground"—that is, out of the ordinary elements of Nature—are our own bodies formed, and the bodies of all living things. Nor is there anything which should shock us in the idea that the

creation of new forms, any more than their propagation, has been brought about by the use and instrumentality of means. In a theological point of view it matters nothing what those means have been. I agree with M. Guizot when he says that "Those only would be serious adversaries of the doctrine of creation who could affirm that the universe—the earth, and man upon it—have been from all eternity, and in all respects, just what they are now." But this cannot be affirmed except in the teeth of facts which science has clearly ascertained. There has been a continual coming-to-be of new forms of life. This is creation, no matter what have been the laws or forces employed by creative power.—ARGYLL *Reign of Law*, ch. 5, p. 156. (Burt.)

682. CREATION AND MAINTENANCE ONE IN ESSENCE—*Divine Power Acts by Wisdom and Knowledge.*—Whatever the ultimate relation may be between mental and material force, we can at least see clearly this—that in Nature there is the most elaborate machinery to accomplish purpose through the instrumentality of means. It seems as if all that is done in Nature, as well as all that is done in art, were done by knowing how to do it. It is curious how the language of the great seers of the Old Testament corresponds with this idea. They uniformly ascribe all the operations of Nature—the greatest and the smallest—to the working of divine power. But they never revolt—as so many do in these weaker days—from the idea of this power working by wisdom and knowledge in the use of means; nor, in this point of view, do they ever separate between the work of first creation and the work which is going on daily in the existing world. Exactly the same language is applied to the rarest exertions of power, and to the gentlest and most constant of all natural operations. Thus the saying that "The Lord by wisdom hath founded the earth; by understanding hath he established the heavens," is coupled in the same breath with this other saying, "By his knowledge the depths are broken up, and the clouds drop down the dew" [Prov. iii, 19-20].—ARGYLL *Reign of Law*, ch. 3, p. 77. (Burt.)

683. CREATION A PRESENT FACT—*Suns Forming Now—Partially Condensed Nebulæ—Intense Heat and Activity of Gases Composing Them.*—The aspect and the chemical analysis of these nebulæ have brought again into favor the hypothesis of cosmical matter originally scattered through all space. A first condensation of this diffuse matter produces clouds of vapors or simple nebulæ. By a subsequent condensation one or more nuclei are formed in these nebulosities. These nuclei, attracting the surrounding matter, gradually increase and become stars, which afterwards, by their mutual attraction, approach each other, and group themselves into stellar clusters. We thus see nebulæ at all ages of their organization. In order to develop in the gases lines as clear and sharp as those revealed by spectrum analysis, ordinary combustion accompanied by a feeble disengagement of heat would not suffice; on the contrary, a very elevated temperature is necessary, like that produced by the electric focus. We may conclude that the fluids which constitute the nebulæ are in a state of vivid incandescence, at a temperature at least as elevated as those which we can raise. The depths of space, which are usually presented to our mind as the seat of a glacial silence, similar to that of death, are then, on the contrary, in a state of tremendous activity which our imagination can hardly conceive. Thus suns are prepared which one day, when sufficiently condensed and cooled, will rule and illuminate a certain number of planets. The planetary nebulæ seem to be bodies already very far advanced in this way of formation. We know a compound body, of which the position is 19 hours 40 minutes of right ascension and 50° 6′ of northern declination; this is a star surrounded by a nebulous atmosphere, presenting at the same time two spectra—which seems to indicate an intermediate phase of sidereal formations.—FLAMMARION *Popular Astronomy*, p. 664. (A.)

684. CREATION BY DEVELOPMENT—*A Long Course of Slow Modification—Indications of Evolution in Orchids.*—Can we feel satisfied by saying that each orchid was created, exactly as we now see it, on a certain "ideal type"; that the omnipotent Creator, having fixed on one plan for the whole order, did not depart from this plan; that he, therefore, made the same organ to perform diverse functions—often of trifling importance compared with their proper function—converted other organs into mere purposeless rudiments, and arranged all as if they had to stand separate, and then made them cohere? Is it not a more simple and intelligible view that all the *Orchideæ* owe what they have in common to descent from some monocotyledonous plant, which, like so many other plants of the same class, possessed fifteen organs, arranged alternately three within three in five whorls; and that the now wonderfully changed structure of the flower is due to a long course of slow modification—each modification having been preserved which was useful to the plant, during the incessant changes to which the organic and inorganic world has been exposed?—DARWIN *Fertilization of Orchids*, ch. 8, p. 245. (A., 1898.)

685. CREATION BY SECOND CAUSES—*God Works by Law—Law Makes Science Possible—Science Will Not Discover Too Much.*—We may be stopped indeed at the threshold of the inquiry by the suggestion that so many thousands of years ago the comets were launched upon the paths which they are now pursuing, and at such dis-

tances from the sun as to come into view at their respective times. But I may be permitted, I trust, to reject altogether such a solution as this, not assuredly because I question the Creator's power so to arrange matters if it had pleased him, but because it is rendered manifest by the most certain scientific evidence that this has not been the Creator's pleasure; that, on the contrary, he has chosen to work all things by law. It is indeed only because this is so that science has any power to ascertain the meaning of processes going on around us. It is by the recognition of law in the universe that we are led from "Nature up to Nature's God," and they err who would stay the researches which lead to the discovery of the laws of the universe, by the simple explanation that "God so willed." That he did so is certain; but science is not therefore to be checked in its inquiries, as tho there were fear of her discovering too much. The time has not yet come, nor is it likely to come, when science need take her shoes from off her feet, because of her too near approach to the great First Cause and because in that sense the ground on which she stands is holy ground. She stands on holy ground now, and has always so stood, because she deals with the ways and works of the Creator. But she approaches no nearer to the First Cause in inquiring into the birth of the solar system than in watching the growth of an ephemeron.—PROCTOR *Expanse of Heaven*, p. 137. (L. G. & Co.)

686. CREATION HIGHER THAN DESTRUCTION—*Achievement Grander than Emotion.*—Perhaps it might once for all be stated, as a law of vital action, that the dignity of the force is in an inverse ratio to its volumetrical display. It is indeed with organic action as it is with mental action. The emotional man displays considerable force, and often produces great effects in the way of destruction, but his power is vastly inferior to that of the man who has developed emotional force into the higher form of will-force, who has coordinated the passions into the calm, self-contained activity of definite productive aim. Surely, creation always testifies to a much higher energy than destruction.—MAUDSLEY *Body and Mind*, essay 3, p. 249. (A., 1898.)

687. CREATION, LENGTH OF PERIOD OCCUPIED IN—*Planetary System—Comparative Brevity of Human History.*—The length of time required by the condensation to which the primitive nebula was subjected in order to constitute our planetary system entirely defies our imagination. To count it by thousands of millions of centuries would not be an exaggeration. The experiments of Bischof on basalt seem to prove that in order to pass from the liquid state to the solid state, to cool from 2,000 degrees to 200, our globe has required 350 millions of years. The sun has existed for many more millions of centuries. What is the whole history of mankind compared with such periods?—a wave upon the ocean.—FLAMMARION *Popular Astronomy*, bk. i, ch. 7, p. 76. (A.)

688. CREATION NOT LIMITED IN METHOD—*Scripture Draws No Line between Natural and Supernatural.*—But whatever may have been the method or process of creation, it is creation still. If it were proved to-morrow that the first man was "born" from some preexisting form of life, it would still be true that such a birth must have been, in every sense of the word, a new creation. It would still be as true that God formed him "out of the dust of the earth" as it is true that he has so formed every child who is now called to answer the first question of all theologies. And we must remember that the language of Scripture nowhere draws, or seems even conscious of, the distinction which modern philosophy draws so sharply between the natural and the supernatural. All the operations of Nature are spoken of as operations of the Divine Mind. Creation is the outward embodiment of a divine idea. It is in this sense, apparently, that the narrative of Genesis speaks of every plant being formed "before it grew" [Gen. ii, 5]. But the same language is held, not less decidedly, of every ordinary birth. "Thine eyes did see my substance, yet being imperfect. In thy book all my members were written, which in continuance were fashioned, when as yet there were none of them." And these words, spoken of the individual birth, have been applied not less truly to the modern idea of the genesis of all organic life. Whatever may have been the physical or material relation between its successive forms, the ideal relation has been now clearly recognized, and reduced to scientific definition.—ARGYLL *Reign of Law*, ch. 1, p. 18. (Burt.)

689. CREATION STILL IN PROGRESS—*Jupiter Yet in Its "Geologic Age"—A Red-hot Planet.*—It would indeed seem as tho the actual globe of Jupiter were red-hot; since from time to time, when the great white cloud-belt which surrounds his torrid regions has been dispersed, a strange fiery hue has been observed over this zone, which strongly suggests the idea of a glowing central globe. And when the light of Jupiter has been measured it has been found to exceed that which would be given by a globe of equal size simply reflecting the sun's light.—PROCTOR *Expanse of Heaven*, p. 83. (L. G. & Co., 1897.)

690. ——— ——— *Life on the Moons of Jupiter.*—Jupiter appears to be a world still in process of formation, which lately—some thousands of centuries ago—served as a sun to his own system of four [five, or perhaps more] worlds. If the central body is not at present inhabited, his satellites may be. In this case, the magnificence of the spectacle presented by Jupiter himself

to the inhabitants of the satellites is worthy of our attention. Seen from the first satellite, the Jovian globe presents an immense disk of twenty degrees in diameter, or 1,400 times larger than the full moon! What a body! What a picture, with its belts, its cloud-motions, and its glowing coloration, seen from so near! What a nocturnal sun!—still warm, perhaps. Add to this the aspect of the satellites themselves seen from each other, and you have a spectacle of which no terrestrial night can give an idea.—FLAMMARION *Popular Astronomy*, bk. iv, ch. 7, p. 429. (A.)

691. ———— *The Nebula of Orion —A Vast Aggregation of Gaseous Matter—Wider than Our Solar System—Nebulæ That Cannot Be Resolved—Unformed Matter.*—On a very clear and transparent night of winter, at midnight in December, look below the belt of Orion and you will distinguish the mass of nebulous light which glimmers in that constellation. Take a telescope, even of small power, and you remark the beautiful quadruple star (it is even sextuple), θ Orionis, surrounded by the most curious of nebulæ. Here is no cluster of suns; it is luminous, gaseous matter, a little greenish. The spectroscope shows in its spectrum three bright lines sharply defined, and separated by dark intervals. A spectrum of this nature can only be produced by light which emanates from matter in the state of gas. What is this cosmical gas? [Recent researches show that this nebula contains hydrogen, but not nitrogen.—J. E. GORE.] This immense nebula, the finest in the heavens, occupies a space much vaster than our whole planetary system!—FLAMMARION *Popular Astronomy*, bk. vi, ch. 10, p. 633. (A.)

692. CREATION, SYSTEM OF, IN KORAN—*Mohammedan Intolerance a Check upon Science.*—The cosmological opinions expressed in the Koran are few, and merely introduced incidentally; so that it is not easy to understand how they could have interfered so seriously with free discussion on the former changes of the globe. The Prophet declares that the earth was created in two days, and the mountains were then placed on it; and during these, and two additional days, the inhabitants of the earth were formed; and in two more the seven heavens. There is no more detail of circumstances; and the deluge, which is also mentioned, is discussed with equal brevity. The waters are represented to have poured out of an oven—a strange fable, said to be borrowed from the Persian Magi, who represented them as issuing from the oven of an old woman. All men were drowned, save Noah and his family; and then God said: "O earth, swallow up thy waters; and thou, O heaven, withhold thy rain," and immediately the waters abated.—LYELL *Principles of Geology*, bk. i ch. 3, p. 18. (A., 1854.)

693. CREATION TRANSCENDS HUMAN THOUGHT—*"With Whom Took He Counsel, or Who Instructed Him?" (Is. xl, 12)—"Where Wast Thou when I Laid the Foundations of the Earth?" (Job xxxviii, 4-12).*—In one form or another, if we speculate at all on the development of the planetary system, our speculations are driven into conformity with the broad lines of the nebular hypothesis—so far, at least, as admitting an original material unity and motive uniformity. But we can see now, better than formerly, that these supply a bare and imperfect sketch of the truth. We should err gravely were we to suppose it possible to reconstruct, with the help of any knowledge our race is ever likely to possess, the real and complete history of our admirable system. "The subtlety of Nature," Bacon says, "transcends in many ways the subtlety of the intellect and senses of man." By no mere barren formula of evolution, indiscriminately applied all round, the results we marvel at, and by a fragment of which our life is conditioned, were brought forth; but by the manifold play of interacting forces, variously modified and variously prevailing, according to the local requirements of the design they were appointed to execute.—CLERKE *History of Astronomy*, pt. ii, ch. 9, p. 391. (Bl., 1893.)

694. CREATOR CANNOT BE DEMONSTRATED—*Origin of Life a Mystery—Decision Must Be upon Facts.*—I grant that we have no such evidence of an active creative power as science requires for positive demonstration of her laws, and that we cannot explain the processes which lie at the origin of life. . . . I bring this subject before you now, not to urge upon you this or that theory, strong as my own convictions are. . . . Whatever be your ultimate opinions on this subject, let them rest on facts and not on arguments, however plausible. This is not a question to be argued. it is one to be investigated.—AGASSIZ *Journey in Brazil*, ch. 1, p. 43. (H. M. & Co., 1896.)

695. CREATURES OF FANCY—*"Naked Specks of Protoplasm."*—"What present warrant," it has been asked, "is there for supposing that a naked, or almost naked, speck of protoplasm can withstand four, six, or eight hours' boiling?" Regarding naked specks of protoplasm I make no assertion. I know nothing about them, save as the creatures of fancy. But I do affirm, not as a "supposition," nor an "assumption," nor a "probable guess," nor as "a wild hypothesis," but as a matter of the most undoubted fact, that the spores of the hay bacillus, when thoroughly desiccated by age, have withstood the ordeal mentioned [four to eight hours' boiling].—TYNDALL *Floating Matter of the Air*, essay 3, p. 307. (A., 1895.)

696. CREDULITY ACCEPTING WORTHLESS REMEDIES—*The Silkworm Plague.*—Pamphlets about the plague [disease of silkworms] had been showered upon the public, the monotony of waste paper being broken, at rare intervals, by a more or less useful publication. "The pharmacopœia of the silkworm," wrote M. Cornalia in 1860, "is now as complicated as that of man. Gases, liquids, and solids have been laid under contribution. From chlorin to sulfurous acid, from nitric acid to rum, from sugar to sulfate of quinin—all has been invoked in behalf of this unhappy insect." The helpless cultivators, moreover, welcomed with ready trustfulness every new remedy, if only pressed upon them with sufficient hardihood. It seemed impossible to diminish their blind confidence in their blind guides. In 1863 the French Minister of Agriculture signed an agreement to pay 500,000 francs for the use of a remedy which its promoter declared to be infallible. It was tried in twelve different departments of France, and found perfectly useless. In no single instance was it successful.—TYNDALL *Floating Matter of the Air,* essay 1, p. 10. (A., 1895.)

697. CRIME NOT EXCUSED BY INTOXICATION—The time may perhaps come when the man who voluntarily resigns that self-directing power which is the noblest gift of his Creator, and gives himself over to the domination of rage, lust, jealousy, or any other bad passion which may be excited by the action of alcohol on his brain, may be regarded as not less criminal than an engine-driver who should raise the fire of his locomotive to an extra heat, and bring up its steam to its highest pressure, and then abandon it, after starting it on a career of destruction.—CARPENTER *Mental Physiology,* bk. ii, ch. 17, p. 651. (A., 1900.)

698. CRIMINALS OFTEN MORAL IMBECILES—*Physical, Mental, and Moral Degenerates—Juvenile Offenders.*—Now, if there be a class of persons who are without the moral sense, who are true moral imbeciles, it is the class of habitual criminals. All observers who have made them their study agree that they constitute a morbid or degenerate variety of mankind, marked by peculiar low physical and mental characteristics. They are scrofulous, often deformed, with badly formed, angular heads, are stupid, sluggish, deficient in vital energy, and sometimes afflicted with epilepsy. They are of weak and defective intellect, tho excessively cunning; and now a few of them are weak-minded and imbecile. The women are ugly in features, and without grace of expression or movement. The children who become juvenile criminals do not evince the educational aptitude of the higher industrial classes; they are deficient in the power of attention and application, have bad memories, and make slow progress in learning; many of them are weak in mind and body, and some of them actually imbecile. At the end of the best part of a life spent among prisoners, a prison surgeon declares himself to be mainly impressed with their extreme deficiency or perversion of moral feeling, the strength of the evil propensities of their nature, and their utter impracticability; neither kindness nor severity availing to prevent them from devising and doing wrong day by day, altho their conduct brought on them further privations.—MAUDSLEY *Body and Mind,* lect. 4, p. 110. (A., 1898.)

699. CRIMSON OF SUNSET AND SUNRISE—*Mountain-tops Shine Like Rubies—Glory Due to Dust.*—The action of the particles [of matter suspended in the air] upon the solar light increases with the atmospheric distances traversed by the sun's rays. The lower the sun, therefore, the greater the action. The shorter waves of the spectrum being more and more withdrawn, the tendency is to give the longer waves an enhanced predominance in the transmitted light. The tendency, in other words, of this light, as the rays traverse ever-increasing distances, is more and more towards red. This, I say, might be stated as an inference, but it is borne out in the most impressive manner by facts. When the Alpine sun is setting, or, better still, some time after he has set, leaving the limbs and shoulders of the mountains in shadow, while their snowy crests are bathed by the retreating light, the snow glows with a beauty and solemnity hardly equaled by any other natural phenomenon. So, also, when first illumined by the rays of the unrisen sun, the mountain-heads, under favorable atmospheric conditions, shine like rubies. And all this splendor is evoked by the simple mechanism of minute particles, themselves without color, suspended in the air.—TYNDALL *Fragments of Science,* vol. i, ch. 5, p. 141. (A., 1897.)

700. CRITICISM OF THE HUMAN EYE—*Practical Perfection through Theoretical Defects.*—The perfection of this adaptation [of the human eye], however, has been partially denied by several modern writers, who have based their denial on a statement contained in a most interesting and instructive lecture on "The Eye and Vision," given some years ago by my very distinguished friend, Professor Helmholtz. The first part of this lecture is devoted to an exposition of the structure and actions of the eye, considered merely as an optical instrument, and of those more recent researches which have shown that, in addition to retinal defects previously known, the eye is not perfectly corrected for either spherical or chromatic aberration, that the crystalline lens has by no means the perfect clearness it has been supposed to possess, and that its fibrous structure produces an irregular radiation in the image of any single bright point. "Now, it is not too much to say," continues the lecturer, "that if an optician wanted to sell

me an instrument which had all these defects, I should think myself quite justified in blaming his carelessness in the strongest terms, and giving him back his instrument." . . . Yet I have seldom met with a case so unfair as the citation of this statement without any of the qualifications which it subsequently receives. Thus, after showing that these defects scarcely reveal themselves in our ordinary vision—some of them requiring most refined methods of observation for their detection—Professor Helmholtz continues: "If I am asked why I have spent so much time in explaining the imperfection of the eye, I answer, as I said at first, that I have not done so in order to depreciate the performances of this wonderful organ, or to diminish our admiration of its construction. It was my object to make my readers understand, at the outset of our inquiry, that it is not any mechanical perfection of the organs of our senses which secures for us such wonderfully true and exact impressions of the outer world. The extraordinary value of the eye depends on the way in which we use it: its perfection is practical, not absolute, consisting not in the avoidance of every error, but in the fact that all its defects do not prevent its rendering us the most important and varied services." This "practical perfection" he afterwards defines as "adaptation to the wants of the organism"; the defects of the eye as an optical instrument being "all so counteracted that the inexactness of the image which results from their presence very little exceeds, under ordinary conditions of illumination, the limits which are set to the delicacy of sensation by the dimensions of the retinal cones."—CARPENTER *Nature and Man*, lect. 15, p. 422. (A., 1889.)

701. CRITICISM ON INADEQUATE DATA—*Geology Needs Wide Observation.*—If it be thus unsafe, however, to calculate on the depth of deposits by the altitude of hills, it is quite as unsafe for the geologist, who has studied a formation in one district, to set himself to criticize the calculations of a brother geologist by whom it has been studied in a different and widely separated district. A deposit in one locality may be found to possess many times the thickness of the same deposit in another.—MILLER *The Old Red Sandstone*, ch. 2, p. 25. (G. & L., 1851.)

702. CROWS AS DISTRIBUTERS OF SEED—*Birds That Thrive on Poison-ivy.*—Professor Barrows writes: "Crows spend only the hours of darkness at the roosts, while during at least twelve hours each day they are dispersed far and wide over the surrounding country, collecting and distributing seeds. The process of digestion—at least the preliminary process—is very rapid in crows. A caged crow, experimented on during several months in the winter of 1889-90, ate berries of poison-ivy with greater relish than any other wild fruit obtainable. He swallowed about eighty berries within a few moments, taking several mouthfuls of sand immediately afterwards; and about thirty minutes later he disgorged a large pellet, consisting entirely of sand and the seeds of the poison-ivy berries, the latter with every shred of pulp removed by the gizzardlike action of the stomach."—WEED *Seed-travellers*, pt. ii, p. 44. (G. & Co., 1899.)

703. CRUCIFYING THE FLESH—*Sustained Ideal Will Control Action.*—The strong-willed man, however, is the man who hears the still small voice unflinchingly, and who, when the death-bringing consideration comes, looks at its face, consents to its presence, clings to it, affirms it, and holds it fast, in spite of the host of exciting mental images which rise in revolt against it and would expel it from the mind. Sustained in this way by a resolute effort of attention, the difficult object erelong begins to call up its own congeners and associates, and ends by changing the disposition of the man's consciousness altogether. And with his consciousness his action changes, for the new object, once stably in possession of the field of his thoughts, infallibly produces its own motor effects. The difficulty lies in the gaining possession of that field.' Tho the spontaneous drift of thought is all the other way, the attention must be kept strained on that one object until at last it grows, so as to maintain itself before the mind with ease. . . . The mysterious tie between the thought and the motor centers next comes into play, and, in a way which we cannot even guess at, the obedience of the bodily organs follows as a matter of course.—JAMES *Psychology*, vol. ii, ch. 26, p. 563. (H. H. & Co., 1899.)

704. CRUELTY, ANCIENT, IN TREATMENT OF THE INSANE—*Brutality Resulting from Belief in Demoniac Possession.*—It was the natural result of such [medieval] views of insanity that men should treat him whom they believed to have a devil in him as they would have treated the devil could they have had the good fortune to lay hold of him. The tortures which the insane suffered from the devils that had entered into him were less than those inflicted by the devils who took charge of him. When he was not put to death as a heretic or a criminal, he was confined in a dungeon, where he lay chained on straw; his food was thrown in, and the straw raked out, through the bars; sightseers went to see him, as they went to see the wild beasts, for amusement; he was cowed by the whip, or other instrument of punishment, and was more neglected and worse treated than if he had been a wild beast. Many insane persons, too, were without doubt executed as witches, or as persons who had, through witchcraft, entered into compact with Satan.—MAUDSLEY *Body and Mind*, lect. 4, p. 102. (A., 1898.)

705. CRUELTY WELLS UP FROM THE LOWER NATURE—*A Survival of Barbarism—Easily Developed by Encouragement.*—As Rochefoucauld says, there is something in the misfortunes of our very friends that does not altogether displease us; and an apostle of peace will feel a certain vicious thrill run through him, and enjoy a vicarious brutality, as he turns to the column in his newspaper at the top of which "Shocking Atrocity" stands printed in large capitals. See the ignoble crew that escorts every great pugilist—parasites who feel as if the glory of his brutality rubbed off upon them, and whose darling hope, from day to day, is to arrange some set-to of which they may share the rapture without enduring the pains! The first blows at a prize-fight are apt to make a refined spectator sick; but his blood is soon up in favor of one party, and it will then seem as if the other fellow could not be banged and pounded and mangled enough—the refined spectator would like to reenforce the blows himself. Over the sinister orgies of blood of certain depraved and insane persons let a curtain be drawn, as well as over the ferocity with which otherwise fairly decent men may be animated, when (at the sacking of a town, for instance), the excitement of victory long delayed, the sudden freedom of rapine and of lust, the contagion of a crowd, and the impulse to imitate and outdo, all combine to swell the blind drunkenness of the killing instinct, and carry it to its extreme. No! those who try to account for this from above downwards, as if it resulted from the consequences of the victory being rapidly inferred, and from the agreeable sentiments associated with them in the imagination, have missed the root of the matter. Our ferocity is blind, and can only be explained from below. Could we trace it back through our line of descent, we should see it taking more and more the form of a fatal reflex response, and at the same time becoming more and more the pure and direct emotion that it is.—JAMES *Psychology*, vol. ii, ch. 24, p. 413. (H. H. & Co., 1899.)

706. CRY OF FOSTER-PARENT NOT UNDERSTOOD—*Bird Learns Only from Its Own Kind.*—I am very familiar with the manners of the parasitical starling or cowbird of South America. The warning cries of the foster-parent have no effect on the young cowbird at any time. Until they are able to fly they will readily devour worms from the hand of a man, even when the old birds are hovering close by and screaming their danger notes, and while their own young, if the parasite has allowed any to survive in the nest, are crouching down in the greatest fear. After the cowbird has left the nest it is still stupidly tame, and more than once I have seen one carried off from its elevated perch by a milvago hawk, when, if it had understood the warning cry of the foster-parent, it would have dropped down into the bush or grass and escaped. But as soon as the young cowbirds are able to shift for themselves, and begin to associate with their own kind, their habits change, and they become suspicious and wild like other birds.—HUDSON *Naturalist in La Plata*, ch. 5, p. 90. (C. & H., 1895.)

707. CRYSTALLIZATION REQUIRES TIME—*Enforced Suddenness Produces Imperfection—Illustrates Revolutionary Action in Society.*—The condition of perfect crystallization is, that the crystallizing force shall act with deliberation. There should be no hurry in its operations; but every molecule ought to be permitted, without disturbance from its neighbors, to exercise its own rights. If the crystallization be too sudden, the regularity disappears. Water may be saturated with sulfate of soda, dissolved when the water is hot, and afterwards permitted to cool. When cold the solution is supersaturated; that is to say, more solid matter is contained in it than corresponds to its temperature. Still the molecules show no sign of building themselves together. This is a very remarkable tho a very common fact. The molecules in the center of the liquid are so hampered by the action of their neighbors that freedom to follow their own tendencies is denied to them. Fix your mind's eye upon a molecule within the mass. It wishes to unite with its neighbor to the right, but it wishes equally to unite with its neighbor to the left; the one tendency neutralizes the other, and it unites with neither. But, if a crystal of sulfate of soda be dropped into the solution, the molecular indecision ceases. On the crystal the adjacent molecules will immediately precipitate themselves; on these again others will be precipitated, and this act of precipitation will continue from the top of the flask to the bottom, until the solution has, as far as possible, assumed the solid form. The crystals here produced are small, and confusedly arranged. The process has been too hasty to admit of the pure and orderly action of the crystallizing force. It typifies the state of a nation in which natural and healthy change is resisted, until society becomes, as it were, supersaturated with the desire for change, the change being then effected through confusion and revolution.—TYNDALL *Lectures on Light*, lect. 3, p. 102. (A., 1898.)

708. CRYSTALS, ARTIFICIAL—*Man Gives Scope to Innate Law of Matter—Each Substance Has Its Own Crystalline Form.*—Everywhere in Nature we observe this tendency to run into definite forms, and nothing is easier than to give scope to this tendency by artificial arrangements. Dissolve niter in water, and allow the water slowly to evaporate; the niter remains, and the solution soon becomes so concentrated that the liquid condition can no longer be preserved. The niter-molecules approach each other, and come at length within the range

of their polar forces. They arrange themselves in obedience to these forces, a minute crystal of niter being at first produced. On this crystal the molecules continue to deposit themselves from the surrounding liquid. The crystal grows, and finally we have large prisms of niter, each of a perfectly definite shape. Alum crystallizes with the utmost ease in this fashion. The resultant crystal is, however, different in shape from that of niter, because the poles of the molecules are differently disposed. If they be only nursed with proper care, crystals of these substances may be caused to grow to a great size.—TYNDALL *Lectures on Light*, lect. 3, p. 102. (A., 1898.)

709. CURIOSITY A TRAIT OF SEALS—*Music and Church Bells Attract Them.*—[The common seal], like other species of the group, is certainly attracted by musical sounds; probably only through curiosity, because it is similarly attracted by any unusual movements. Mr. Bell tells us, in his "British Quadrupeds," that, in the Orkney Islands, if people are passing in boats, seals will often come quite close up to the boat, and stare at them, following for a long time together; if people speak loud, they seem to wonder what may be the matter! The Church of Hoy, in Orkney, is situated near a small sandy bay, much frequented by these creatures, and it was observed that when the bell rang for divine service all the seals within hearing swam directly for the shore, and kept looking about them, as if surprised rather than frightened, and this continued as long as the bells rang.—MIVART *Types of Animal Life*, ch. 10, p. 289. (L. B. & Co., 1893.)

710. CURIOSITY OF MONKEYS—Mr. Darwin, who, in order to test the statement of Brehm that monkeys have an instinctive dread of snakes, and yet cannot "desist from occasionally satiating their curiosity in a most human fashion, by lifting up the lid of the box in which the snakes were kept," took a stuffed snake to the monkey-house at the Zoological Gardens. Mr. Darwin says: "The excitement thus caused was one of the most curious spectacles I ever beheld. . . . I then placed a live snake in a paper bag, with the mouth loosely closed, in one of the larger compartments. One of the monkeys immediately approached, cautiously opened the bag, peeped in, and instantly dashed away. Then I witnessed what Brehm has described, for monkey after monkey, with head raised high and turned on one side, could not resist taking a momentary peep into the upright bag, at the dreadful object lying quietly at the bottom."—ROMANES *Animal Intelligence*, ch. 17, p. 477. (A., 1899.)

711. CURRENT OF ELECTRICITY NON-EXISTENT—*A Figure of Speech—Electric Action by Atomic Motion—The Row of Bricks.*—Having established the so-called electric current, we will now try to show you that there really is no current. The idea of a current involves the idea of a fluid substance flowing from one point to another. When you were a boy did you never set up a row of bricks on their ends, just far enough apart so that if you pushed one over they all fell one after another? Now, imagine rows of molecules or atoms, and in your imagination they may be arranged like the bricks, so that they are affected one by the other successively with a rapidity that is akin to that of light-waves, and you can conceive how a motion may be communicated from end to end of a wire hundreds of miles in length in a small fraction of a second, and no material substance has been carried through the wire—only energy. We do not mean to say that the row of bricks illustrates the exact mode of molecular or atomic motion that takes place in a conductor. What we mean is, that in some way motion is passed along from atom to atom.—ELISHA GRAY *Nature's Miracles*, vol. iii, ch. 6, p. 53. (F. H. & H., 1900.)

712. CURRENTS AS A MEANS OF DISTRIBUTION OF ANIMAL ORGANISMS—By far the greater number of invertebrate animals freely swimming or floating in water are incapable of offering any resistance to the current, and are therefore carried along in the direction which the current itself takes. All the larvæ of sponges, polyps, annelida, tunicata, echinodermata, and very many mollusca, . . . and the medusæ, tho many of these are provided with special swimming organs, are perfectly incapable of swimming against the feeblest stream. The only invertebrate animals which are able to overcome perhaps the strongest currents are the cuttlefishes.

The well-known wealth of forms in the Mediterranean and in the Red Sea owes its origin, certainly in great part, to the action of the constant marine currents. Both these seas are connected with the ocean only by narrow straits through which a superficial current incessantly flows in. The strength of these currents may vary with the time of year and the direction of the prevailing winds, but their direction is invariable the whole year through. Hence all the animals drifting on or just below the surface, when once they have been carried in through these narrow straits, cannot easily get back to the open ocean, and so all the forms that never sink below a certain inconsiderable depth must remain in the inland sea, and only those few species or individuals which reach the deeper return current and do not leave it can be in a position to be borne back by it to the ocean. Consequently both these seas, by reason of the inflowing surface currents, are a sort of trap; everything can get in, but nothing can get out again; thus it is inevitable—and it is actually the case—that a vast accumulation of species as well as of individuals occurs in these seas, wherever

the other necessary conditions for the existence of the individual forms exist.—SEMPER *Animal Life*, ch. 9, p. 279. (A., 1881.)

713. CURRENTS, ELECTRIC, TRAVERSING THE OCEAN FLOOR—*The Submarine Telegraph.*—And now we come to the most wonderful of all telegraphs—that which transmits messages from continent to continent, for thousands of miles, under the depths of the sea. "Does it not seem all but incredible to you," said Edward Everett in his oration at the opening of Dudley Observatory, "that intelligence should travel for two thousand miles along those slender copper wires far down in the all but fathomless Atlantic, never before penetrated by aught pertaining to humanity, save when some foundering vessel has plunged with her hapless company to the eternal silence and darkness of the abyss? Does it not seem, I say, all but a miracle of art, that the thoughts of living men—the thoughts that we think up here on the earth's surface, in the cheerful light of day—about the markets and the exchanges, and the seasons, and the elections, and the treaties, and the wars, and all the fond nothings of daily life, should clothe themselves with elemental sparks, and shoot with fiery speed in a moment, in the twinkling of an eye, from hemisphere to hemisphere, far down among the uncouth monsters that wallow in the nether seas, along the wreck-paved floor, through the oozy dungeons of the rayless deep; that the last intelligence of the crops, whose dancing tassels will in a few months be coquetting with the west wind on these boundless prairies, should go flashing along the slimy decks of old sunken galleons which have been rotting for ages; that messages of friendship and love, from warm living bosoms, should burn over the cold green bones of men and women whose hearts, once as warm as ours, burst as the eternal gulfs closed and roared over them, centuries ago!"—PARK BENJAMIN *Age of Electricity*, ch. 11, p. 247. (S., 1897.)

714. CURSE OF SLAVERY—*Even Animals Degraded by Becoming Oppressors.*—Here, then [among the slave-making ants], as in the case of nestlings, the food-seeking instinct and the power of distinguishing food by sight have degenerated, and clearly in consequence of disuse. Inasmuch as a colony of red ants always owns plenty of slaves, the food-seeking instinct has become unnecessary, natural selection has ceased to affect it, and it has gradually died out. Other instincts, too, have been lost by these red ants in consequence of their habit of keeping slaves; they have quite forgotten the art of nest-building and in part that of tending their young. Other species of ants devote much attention to their pupæ, moving them about the nest from time to time, and often carrying them out into the air and sun, and they feed their larvæ with the greatest assiduity. But the red slave-making ants have no such instincts; they care nothing for their own young, and the species would become extinct if they were suddenly deprived of their slaves. So it is not only among men that there is a curse upon slavery; even animals become degraded by it.—WEISMANN *Heredity*, vol. ii, ch. 9, p. 26. (Cl. P., 1897.)

715. CUTTING BY GLACIER RESISTLESS—*Gigantic Rasp of Ice—Record "Graven with Iron Pen in Rock Forever" (Job xix, 24).*—On any surface over which water flows we shall find that the softer materials have yielded first and most completely. Hard dikes will be left standing out, while softer rocks around them are worn away—furrows will be eaten into more deeply—fissures will be widened—clay-slates will be wasted—while hard sandstone or limestone and granite will show greater resistance. Not so with surfaces over which the leveling plow of the glacier has passed. Wherever softer and harder rocks alternate, they are brought to one outline: where dikes intersect softer rock, they are cut to one level with it; where rents or fissures traverse the rock, they do not seem to have been widened or scooped out more deeply, but their edges are simply abraded on one line with the adjoining surfaces. Whatever be the inequality in the hardness of the materials of which the rock consists, even in the case of pudding-stone, the surface is abraded so evenly as to leave the impression that a rigid rasp has moved over all the undulations of the land, advancing in one and the same direction and leveling all before it.—AGASSIZ *Geological Sketches*, ser. ii, p. 40. (H. M. & Co., 1896.)

716. CYCLE OF CHANGE—*Life the Builder, Oxygen the Destroyer—Science Has No Explanation of Life.*—While the plant is in great measure made up of non-nitrogenized substances, the animal, on the other hand, consists almost entirely of albuminous compounds. The flesh, the nerves, and the bones of our bodies all contain nitrogen, and, like the vegetable albumen, are prone to decay; and this change is constantly going on in our living members. In a most profound sense, "in the midst of life we are in death." The materials of our bodies are being constantly renewed, and the great mass of their structure changes in less than a year. At every motion of your arm, and at every breath you draw, a portion of the muscles concerned is actually burned up in the effort. During life, in some utterly mysterious manner, beyond the range of all human science, the various gases and vapors of the atmosphere, together with a small amount of a few earthy salts, are elaborated into various organized structures. They first pass into the organism of the plant, and thence are transferred to the body of the animal; but no sooner are they firmly built into the animal tissues than a destructive change begins, by which before

long they are restored to the air or the soil, only to renew the same cycle of ceaseless change. Life, during its whole existence, is an untiring builder, the oxygen of the atmosphere a fell destroyer; and when at last the builders cease, then the spirit takes its heavenward flight, and leaves the frail tenement to its appointed end. Dust returns to the dust, and these mortal mists and vapors to the air.—COOKE *Religion and Chemistry*, ch. 4, p. 99. (A., 1897.)

717. CYCLES OF VOLCANIC ACTION —*Earth's Subterranean Forces Never Still.* —Geologists have been led to the conclusion . . . that the subterranean forces are in a state of continual flux over the surface of the globe. At one point of the earth's crust these forces gradually gather such energy as to rend asunder the superincumbent rock-masses and make themselves manifest at the surface in the series of phenomena characteristic of volcanic action. But after a longer or shorter interval of time—an interval which must probably be measured by millions of years—the volcanic forces die out in that area to make their appearance in another.—JUDD *Volcanoes*, ch. 9, p. 277. (A., 1899.)

718. DANCING AMONG BIRDS—*Amusements of Animals.*—There are human dances in which only one person performs at a time, the rest of the company looking on; and some birds, in widely separated genera, have dances of this kind. A striking example is the Rupicola, or cock-of-the-rock, of tropical South America. A mossy level spot of earth surrounded by bushes is selected for a dancing-place, and kept well cleared of sticks and stones; round this area the birds assemble, when a cock-bird, with vivid orange-scarlet crest and plumage, steps into it, and, with spreading wings and tail, begins a series of movements as if dancing a minuet; finally, carried away with excitement, he leaps and gyrates in the most astonishing manner, until, becoming exhausted, he retires, and another bird takes his place.—HUDSON *Naturalist in La Plata*, ch. 19, p. 261. (C. & H., 1895.)

719. DANCING ANCIENTLY A SIGNIFICANT RITE—*Passionate Fervor of Dancers—Superstitions Connected with Dance.* —Dancing may seem to us moderns a frivolous amusement; but in the infancy of civilization it was full of passionate and solemn meaning. Savages and barbarians dance their joy and sorrow, their love and rage, even their magic and religion. . . . We have enough of the savage left in us to feel how Australians leaping and yelling at a corroboree by firelight in the forest can work themselves up into frenzy for next day's fight. But with our civilized notions it is not so easy to understand that barbarians' dancing may mean still more than this; it seems to them so real that they expect it to act on the world outside. Thus among the Mandan Indians, when the hunters failed to find the buffaloes on which the tribe depended for food, every man brought out of his lodge the mask made of a buffalo's head and horns, with the tail hanging down behind, which he kept for such an emergency, and they all set to dance buffalo. Ten or fifteen masked dancers at a time formed the ring, drumming and rattling, chanting and yelling; when one was tired out he went through the pantomime of being shot with bow and arrow, skinned, and cut up; while another, who stood ready with his buffalo-head on, took his place in the dance. So it would go on, without stopping day or night, sometimes for two or three weeks, till at last these persevering efforts to bring the buffalo succeeded, and a herd came in sight on the prairie.—TYLOR *Anthropology*, ch. 12, p. 296. (A., 1899.)

720. DANCING, RELIGIOUS—*In Ancient Greece and Rome, as in Modern India.* —In ancient religion dancing came to be one of the chief acts of worship. Religious processions went with song and dance to the Egyptian temples, and Plato said that all dancing ought to be thus an act of religion. In fact, it was so to a great extent in Greece, as where the Cretan chorus, moving in measured pace, sang hymns to Apollo, and in Rome, where the Salian priests sang and danced, beating their shields, along the streets at the yearly festival of Mars. Modern civilization, in which sacred music flourishes more than ever, has mostly cast off the sacred dance. To see this near its old state the traveler may visit the temples of India, or among the lamas of Tibet watch the mummers in animal masks dancing the demons out, or the new year in, to wild music of drums and shell-trumpets. Remnants of such ceremonies, come down from the religion of England before Christian times, are still sometimes to be seen in the dances of boys and girls round the midsummer bonfire, or of the mummers at Yuletide; but even these are dying out. The dances of choristers in plumed hats and the dress of pages of Philip III.'s time, still performed before the high altar of Seville Cathedral, are now among the quaintest relics of a rite all but vanished from Christendom.—TYLOR *Anthropology*, ch. 12, p. 297. (A., 1899.)

721. DANGER, HIDDEN — *Vesuvius Seemingly an Extinct Volcano before Eruption of 79.*—From the first colonization of southern Italy by the Greeks, Vesuvius afforded no other indications of its volcanic character than such as the naturalist might infer from the analogy of its structure to other volcanoes. These were recognized by Strabo, but Pliny did not include the mountain in his list of active vents. The ancient cone was of a very regular form, terminating not as at present in two peaks, but with a summit which presented, when seen from a distance, the even outline of an abruptly

truncated cone. On the summit, as we learn from Plutarch, there was a crater with steep cliffs, and having its interior overgrown with wild vines, and with a sterile plain at the bottom. On the exterior, the flanks of the mountain were clothed with fertile fields richly cultivated, and at its base were the populous cities of Herculaneum and Pompeii. But the scene of repose was at length doomed to cease, and the volcanic fire was recalled to the main channel, which at some former unknown period had given passage to repeated streams of melted lava, sand, and scoriæ.—LYELL *Geology*, ch. 23, p. 363. (A., 1854.)

722. DANGER-SIGNALS AMONG ANIMALS—*Warning Coloration a Defense to Its Possessor.*—[Some colorations] are developed for the express purpose of rendering the species conspicuous. The reason of this is that the animals in question are either the possessors of some deadly weapons, as stings or poison-fangs, or they are uneatable, and are thus so disagreeable to the usual enemies of their kind that they are never attacked when their peculiar powers or properties are known. It is, therefore, important that they should not be mistaken for defenseless or eatable species of the same class or order, since in that case they might suffer injury, or even death, before their enemies discovered the danger or the uselessness of the attack. They require some signal or danger-flag which shall serve as a warning to would-be enemies not to attack them, and they have usually obtained this in the form of conspicuous or brilliant coloration, very distinct from the protective tints of the defenseless animals allied to them.—WALLACE *Darwinism*, ch. 9, p. 158. (Hum., 1889.)

723. DANGERS FACED BY SCIENTISTS—*"Mountain Sickness"—Rarefied Air May Be Fatal.*—The years brought round the eclipse of 1878, which was again in United States territory, the central track running directly over one of the loftiest mountains of the country, Pike's Peak, in Colorado. Pike's Peak, tho over fourteen thousand feet high, is often ascended by pleasure tourists; but it is one thing to stay there for an hour or two, and another to take up one's abode there and get acclimated—for to do the latter we must first pass through the horrors (not too strong a word) of mountain sickness. This reaches its height usually on the second or third day, and is something like violent seasickness, complicated with the sensations a mouse may be supposed to have under the bell of an air-pump. After a week the strong begin to get over it, but none but the very robust should take its chances, as we did, without preparation; for on the night before the eclipse the life of one of our little party was pronounced in danger, and he was carried down in a litter to a cabin at an altitude of about ten thousand feet, where he recovered so speedily as to be able to do good service on the following day.—LANGLEY *New Astronomy*, ch. 2, p. 50. (H. M. & Co., 1896.)

724. DANGERS OF ISOLATION—*No Man Sufficient to Himself—The Corrective of Society a Necessity for Sound Thinking.*—Neither is such a practise [of devoting oneself wholly to thinking and teaching without reading or study], in a hygienic point of view, free from the gravest dangers to the philosopher's own mind. When once he has persuaded himself that he can work out the final truth on any subject, exclusively from his own sources, he is apt to lose all measure or standard by which to be apprised when he is departing from common sense. Living only with his own thoughts, he gradually forgets the aspect they present to minds of a different mold from his own; he looks at his conclusions only from the point of view which suggested them, and from which they naturally appear perfect; and every consideration which from other points of view might present itself, either as an objection or as a necessary modification, is to him as if it did not exist. When his merits come to be recognized and appreciated, and especially if he obtains disciples, the intellectual infirmity soon becomes complicated with a moral one. The natural result of the position is a gigantic self-confidence, not to say self-conceit.—MILL *Positive Philosophy of Auguste Comte*, p. 117. (H.H. & Co., 1887.)

725. DARKNESS ATTENDED WITH COLD—*Night for Five Months.*—One of the last expeditions made for the discovery of the north pole—that of the English navigators Nares and Stephenson (May 29, 1875, to November 2, 1877)—which advanced farther than any of its predecessors—up to 82° 24′—had 142 days of solar privation—nearly five months of night! From November 6 to February 6 the night was complete and dark. Even on November 8 the darkness was so complete at noon that it was impossible to read. But soon the moon brought a reflection of the vanished sun, and turned round the pole without ever setting for ten times twenty-four hours. The thermometer went down to 58° centigrade below zero! (It has been seen still lower at Werchojansk, in Siberia—68°.) These low temperatures are never accompanied with wind: otherwise no human being could stand such cold. O icy solitudes of the pole, you have already received heroes who have lain down forever in your gloomy shroud! The road to the pole is always marked with martyrs; but it is not the odious war of man against man: it is the triumph of mind over matter, the conquest of Nature by genius!—FLAMMARION *Popular Astronomy*, p. 31. (A.)

726. DARKNESS BEFORE DAWN OF NEW ERA—*Summary of Human Knowledge of the Stars through All Centuries before 1775.*—A star in the Swan was per-

ceived by Janson in 1600 to show fluctuations of light, and Montanari found, in 1669, that Algol in Perseus shared the same peculiarity to a marked degree. Altogether the class embraced, in 1782, half a dozen members. When it is added that a few star couples had been noted in singularly, but it was supposed accidentally, close juxtaposition, and that the failure of repeated attempts to find an annual parallax pointed to distances for the stars at least 400,000 times that of the earth from the sun, the picture of sidereal science, when the last quarter of the eighteenth century began, is practically complete. It included three items of information: that the stars have motions, real or apparent; that they are immeasurably remote; and that a few shine with a periodically variable light. Nor were the facts thus scantily collected ordered into any promise of further development. They lay at once isolated and confused before the inquirer. They needed to be both multiplied and marshaled, and it seemed as if centuries of patient toil must elapse before any reliable conclusions could be derived from them. The sidereal world was thus the recognized domain of far-reaching speculations, which remained wholly uncramped by systematic research until Herschel entered upon his career as an observer of the heavens.—CLERKE *History of Astronomy*, ch. 1, p. 12. (Bl., 1893.)

727. DARKNESS, COLD, AND PRESSURE IN DEEP SEA—*"In the Lowest Pit, in Darkness, in the Deeps" (Ps. lxxxviii, 6).*—The peculiar physical conditions of the deep seas may be briefly stated to be these: It is absolutely dark so far as actual sunlight is concerned, the temperature is only a few degrees above freezing-point, the pressure is enormous, there is little or no movement of the water, the bottom is composed of a uniform fine soft mud, and there is no plant-life. All of these physical conditions we can appreciate except the enormous pressure. Absolute darkness we know, the temperature of the deep seas is not an extraordinary one, the absence of movement in the water and the fine soft mud are conditions that we can readily appreciate; but the pressure is far greater than anything we can realize.—HICKSON *Fauna of the Deep Sea*, ch. 2, p. 18. (A., 1894.)

728. DARKNESS IN THE DAYTIME—*Far-reaching Effect of Earthquake.*—In April, 1815, one of the most frightful eruptions recorded in history occurred in the province of Tomboro, in the island of Sumbawa, about 200 miles from the eastern extremity of Java. . . . The sound of the explosions was heard in Sumatra, at the distance of 970 geographical miles in a direct line; and at Ternate, in an opposite direction, at the distance of 720 miles. Out of a population of 12,000, in the province of Tomboro, only twenty-six individuals survived. Violent whirlwinds carried up men, horses, cattle, and whatever else came within their influence into the air; tore up the largest trees by the roots, and covered the whole sea with floating timber. Great tracts of land were covered by lava, several streams of which, issuing from the crater of the Tomboro mountain, reached the sea. So heavy was the fall of ashes that they broke into the Resident's house at Bima, forty miles east of the volcano, and rendered it, as well as many other dwellings in the town, uninhabitable. On the side of Java the ashes were carried to the distance of 300 miles, and 217 towards Celebes, in sufficient quantity to darken the air. The floating cinders to the westward of Sumatra formed, on the 12th of April, a mass two feet thick, and several miles in extent, through which ships with difficulty forced their way.

The darkness occasioned in the daytime by the ashes in Java was so profound that nothing equal to it was ever witnessed in the darkest night. Altho this volcanic dust when it fell was an impalpable powder, it was of considerable weight when compressed, a pint of it weighing twelve ounces and three-quarters. "Some of the finest particles," says Mr. Crawfurd, "were transported to the islands of Amboyna and Banda, which last is about 800 miles east from the site of the volcano, altho the southeast monsoon was then at its height." They must have been projected, therefore, into the upper regions of the atmosphere, where a counter-current prevailed.—LYELL *Principles of Geology*, bk. ii, ch. 27, p. 465. (A., 1854.)

729. DARKNESS REVEALS—*The Sun's Bright Corona Seen Only During Eclipse—Unnatural Light Attending Eclipse.*—I have witnessed three total eclipses, but I do not find that repetition dulls the interest. The first was that of 1869, which passed across the United States and was nearly central over Louisville. My station was on the southern border of the eclipse track, not very far from the Mammoth Cave in Kentucky, and I well remember that early experience. The special observations of precision in which I was engaged would not interest the reader; but while trying to give my undivided attention to these, a mental photograph of the whole spectacle seemed to be taking without my volition. First, the black body of the moon advanced slowly on the sun, as we have all seen it do in partial eclipses, without anything noticeable appearing; nor till the sun was very nearly covered did the light of day about us seem much diminished. But when the sun's face was reduced to a very narrow crescent, the change was sudden and startling, for the light which fell on us not only dwindled rapidly, but became of a kind unknown before, so that a pallid appearance overspread the face of the earth with an ugly livid hue; and as this strange wanness increased, a cold seemed to come with it. The impres-

sion was of something unnatural; but there was only a moment to note it, for the sun went out as suddenly as a blown-out gas-jet, and I became as suddenly aware that all around, where it had been, there had been growing into vision a kind of ghostly radiance, composed of separate pearly beams, looking distinct each from each, as tho the black circles where the sun once was bristled with pale streamers, stretching far away from it in a sort of crown [the corona].—LANGLEY *New Astronomy*, ch. 2, p. 39. (H. M. & Co., 1896.)

730. DARWINISM NOT ATHEISTIC—*Agnosticism and Monism—Problem of First Organisms.*—Darwinism was not necessarily atheistic or agnostic. Its author was content to assume a few living beings or independent forms to begin with, and did not propose to obtain them by any spontaneous action of dead matter, nor to account for the primary origin of life, still less of all material things. In this he was sufficiently humble and honest; but the logical weakness of his position was at once apparent. If creation was needed to give a few initial types, it might have produced others also. The followers of Darwin, therefore, more especially in Germany, at once pushed the doctrine back into agnosticism and monism, giving to it a greater logical consistency, but bringing it into violent conflict with theism and with common sense.—DAWSON *Facts and Fancies of Modern Science*, lect. 1, p. 52. (A. B. P. S.)

731. DATA, INADEQUATE, LEAD TO ERRONEOUS CONCLUSION—*Emission Theory of Light Justified by the Facts in Newton's Possession.*—The case of Newton still more forcibly illustrates the position, that in forming physical theories we draw for our materials upon the world of fact. Before he began to deal with light, he was intimately acquainted with the laws of elastic collision, which all of you have seen more or less perfectly illustrated on a billiard-table. As regards the collision of sensible masses, Newton knew the angle of incidence to be equal to the angle of reflection, and he also knew that experiment . . . had established the same law with regard to light. He thus found in his previous knowledge the material for theoretic images. He had only to change the magnitude of conceptions already in his mind to arrive at the emission theory of light. He supposed light to consist of elastic particles of inconceivable minuteness shot out with inconceivable rapidity by luminous bodies, and that such particles impinging upon smooth surfaces were reflected in accordance with the ordinary law of elastic collision. The fact of optical reflection certainly occurred as if light consisted of such particles, and this was Newton's sole justification for introducing them.—TYNDALL *Lectures on Light*, lect. 2, p. 45. (A., 1898.)

732. DAWN OF MOTHERLY VIRTUES—*Patience—Sympathy—Carefulness—Tenderness.*—Begin at the beginning again and recall the fact of woman's passive strain. A tendency to passivity means, among other things, a capacity to sit still. Be it but for a minute or an hour does not matter; the point is that the faintest possible capacity is there. For this is the embryo of patience, and if much and long nursed a fully fledged patience will come out of it. Supply next to this new virtue some definite object on which to practise, let us say a child. When this child is in trouble the mother will observe the signs of pain. Its cry will awaken associations, and in some dull sense the mother will feel with it. But "feeling with another" is the literal translation of the name of a second virtue—sympathy. From feeling with it, the parent will sooner or later be led to do something to help it; then it will do more things to help it; finally it will be always helping it. Now, to care for things is to become careful; to tend things is to become tender. Here are four virtues—patience, sympathy, carefulness, tenderness—already dawning upon mankind.—DRUMMOND *Ascent of Man*, p. 288. (J. P., 1900.)

733. DAY'S JOURNEY—*A Primitive Measure of Distance.*—The day's journey is often mentioned as a fixed distance. This is only true within wide limits, and it scarcely ever exceeds ten miles for marching. "The Indians, finding that their wives were so near as to be within one of their ordinary days' work, which seldom exceeded ten or twelve miles, determined not to rest till they had joined them."—MASON *Aboriginal American Mechanics, Memoirs of the International Congress of Anthropology*, p. 79. (Sch. P. C.)

734. DEATH, A SCIENTIST'S DEFINITION OF—*Frozen Caterpillar Revived.*—I would define death as an arrest of life, from which no lengthened revival, either of the whole or any of its parts, can take place; or, to put it concisely, as a definite arrest of life. . . . For the conception itself it is quite immaterial whether we are able to decide if death has really taken place in any particular case; however uncertain we might be, the state which we call death would be not less sharply and definitely limited. We might consider the caterpillar of *Euprepia flavia* to be dead when frozen in ice, but if it recovered after thawing and became an imago, we should say that it had only been apparently dead, that life stood still for a time, but had not ceased forever. It is only the irretrievable loss of life in an organism which we call death, and we ought to hold fast to this conception, so that it will not slip from us, and become worthless, because we no longer know what we mean by it. . . . The real proof of death is that the organized substance which pre-

viously gave rise to the phenomena of life forever ceases to originate such phenomena. This, and this alone, is what mankind has hitherto understood by death.—WEISMANN *Heredity*, vol. i, p. 114. (Cl. P., 1891.)

735. DEATH, SUDDEN, STRANGE FORMS OF—*Persons Engulfed in Earthquake Fissures.*—During the convulsions of 1692 which destroyed Port Royal, it is said that many of the fissures which were formed opened and shut. In some of these, people were entirely swallowed up and buried. In others they were trapped by the middle, and even by the neck, where if not killed instantaneously they perished slowly. Subsequently their projecting parts formed food for dogs. The earthquake which, July 18, 1880, shook the Philippines caused many fissures to be found, which in some places were so numerous that the ground was broken up into steps. Near to the village of San Antonio the soil was so disturbed that the surface of a field of sugar-canes was so altered that in some cases the top of one row of full-grown plants was on a level with the roots of the next. Into one such fissure a boat disappeared, and into another a child. Subsequently the child was excavated, and its body, which was found a short distance below the surface, was completely crushed.—MILNE *Earthquakes*, ch. 8, p. 147. (A., 1899.)

736. DEATH, THE FEIGNING OF, BY ANIMALS—*The Protective Instinct of Immobility.*—In ordinary fear, one may either run or remain semi-paralyzed. The latter condition reminds us of the so-called death-shamming instinct shown by many animals. Dr. Lindsay, in his work "Mind in Animals," says this must require great self-command in those that practise it. But it is really no feigning of death at all, and requires no self-command. It is simply a terror-paralysis which has been so useful as to become hereditary. The beast of prey does not think the motionless bird, insect, or crustacean dead. He simply fails to notice them at all; because his senses, like ours, are much more strongly excited by a moving object than by a still one. It is the same instinct which leads a boy playing "I spy" to hold his very breath when the seeker is near, and which makes the beast of prey himself in many cases motionlessly lie in wait for his victim or silently "stalk" it, by rapid approaches alternated with periods of immobility.—JAMES *Psychology*, vol. ii, ch. 24, p. 420. (H. H. & Co., 1899.)

737. DEATH UNWARNED—*Brain Destroyed before Sensation Can Reach It.*—Now, it is quite conceivable that an injury might be inflicted so rapidly that within the time required by the brain to complete the arrangements necessary to consciousness its power of arrangement might be destroyed. In such a case, tho the injury might be of a nature to cause death, this would occur without pain. Death in this case would be simply the sudden negation of life, without any intervention of consciousness whatever. The time required for a rifle-bullet to pass clean through a man's head may be roughly estimated at a thousandth of a second. Here, therefore, we should have no room for sensation [see SENSATION], and death would be painless.—TYNDALL *Fragments of Science*, vol. i, ch. 21, p. 440. (A., 1900.)

738. DEBT OF CHRISTIAN CIVILIZATION TO MOSLEMS—*Algebra Developed by Arabs—Legacy of Orient to Occident.*—Besides making laudatory mention of that which we owe to the natural science of the Arabs in both the terrestrial and celestial spheres, we must likewise allude to their contributions in separate paths of intellectual development to the general mass of mathematical science. According to recent works . . . on the history of mathematics, we learn that "the algebra of the Arabs originated from an Indian and a Greek source, which long flowed independently of one another." . . . The process of establishing a conclusion by a progressive advance from one proposition to another, which seems to have been unknown to the ancient Indian algebraists, was acquired by the Arabs from the Alexandrian school. This noble inheritance, enriched by their additions, passed in the twelfth century into the European literature of the Middle Ages. "In the algebraic works of the Indians, we find the general solution of indeterminate equations of the first degree, and a far more elaborate mode of treating those of the second, than has been transmitted to us in the writings of the Alexandrian philosophers; there is, therefore, no doubt that if the works of the Indians had reached us two hundred years earlier, and were not now first made known to Europeans, they might have acted very beneficially in favoring the development of modern analysis" [Chasles]. —HUMBOLDT *Cosmos*, vol. ii, pt. ii, p. 223. (H., 1897.)

739. DEBT OF EUROPE TO THE EAST IN EARLY DAYS—*The Use of Bronze.*—Another circumstance which strongly militates against the theory of a gradual and independent development of metallurgical knowledge in different countries is the fact that whenever we find the bronze swords or celts, "whether in Ireland, in the far West, in Scotland, in distant Scandinavia, in Germany, or still further east in the Slavonic countries, they are the same, not similar in character, but identical." . . . Tho there are certain differences, yet several varieties of celts found throughout Europe, as well as some of the swords, knives, daggers, etc., are so similar that they seem as if they must have been cast by the same maker. . . . Under these circumstances, it appears most probable that the knowledge of

metal is one of those great discoveries which Europe owes to the East, and that the use of copper was not introduced into our continent until it had been observed that by the addition of a small quantity of tin it was rendered harder and more valuable.—AVEBURY *Prehistoric Times*, ch. 3, pp. 56-57. (A., 1900.)

740. DEBT OF SCIENCE TO UNLEARNED CONTRIBUTOR—*Discovery of the Mammoth.*—It was an eventful day, not only for science, but for the world, when a Siberian fisherman chanced to observe a singular mound lying near the mouth of the River Lena, where it empties into the Arctic Ocean. During the warmer summer weather, he noticed that, as the snow gradually melted, this mound assumed a more distinct and prominent outline, and at length, on one side of it, where the heat of the sun was greatest, a dark body became exposed, which, when completely uncovered, proved to be that of an immense elephant, in so perfect a state of preservation that the dogs and wolves were attracted to it as by the smell of fresh meat, and came to feed upon it at night. The man knew little of the value of his discovery, but the story went abroad, and an Englishman traveling in Russia, being curious to verify it, visited the spot, and actually found the remains where they had been reported to lie, on the frozen shore of the Arctic Sea—strange burial-place enough for an animal never known to exist out of tropical climates. Little beside the skeleton was left, tho parts of the skin remained covered with hair, showing how perfect must have been the condition of the body when first exposed. The tusks had been sold by the fisherman; but Mr. Adams succeeded in recovering them; and collecting all the bones, except those of one foot, which had been carried off by the wolves, he had them removed to St. Petersburg, where the skeleton now stands in the Imperial Museum.—AGASSIZ *Geological Sketches*, ser. i, ch. 7, p. 182. (H. M. & Co., 1896.)

741. DECAY OF ANCIENT LIFE MINISTERS TO MODERN—*Coal and Mineral Springs—Unseen Laboratories of Nature.*—The bottom and the lower slopes of the valley are occupied by the bituminous and sulfureous schists of the fish-bed, and in these, largely impregnated with the peculiar ingredients of the formation, the famous medicinal springs of the Strath have their rise. They contain, as shown by chemical analysis, the sulfates of soda, of lime, of magnesia, common salt, and, above all, sulfureted hydrogen gas—elements which masses of sea-mud, charged with animal matter, would yield as readily to the chemist as the medicinal springs of Strathpeffer. Is it not a curious reflection, that the commercial greatness of Britain, in the present day, should be closely connected with the towering and thickly spread forests of arboraceous ferns and gigantic reeds—vegetables of strange form and uncouth names—which flourished and decayed on its surface, age after age, during the vastly extended term of the Carboniferous period, ere the mountains were yet upheaved, and when there was as yet no man to till the ground? Is it not a reflection equally curious that the invalids of the present summer should be drinking health, amid the recesses of Strathpeffer, from the still more ancient mineral and animal débris of the lower ocean of the Old Red Sandstone, strangely elaborated for vast but unreckoned periods in the bowels of the earth?—MILLER *Old Red Sandstone*, ch. 10, p. 183. (G. & L., 1851.)

742. DECAY OF CREEDS—*Severance of Theology from Nature—This Separation Not Found in Scripture—Spiritual Laws Are Laws of Nature.*—Perhaps it is not too much to say that the manifest decay which so many creeds and confessions are now suffering, arises mainly from the degree in which at least the popular expositions of them dissociate the doctrines of Christianity from the analogy and course of Nature. There is no such severance in Scripture—no shyness of illustrating divine things by reference to the natural. On the contrary, we are perpetually reminded that the laws of the spiritual world are in the highest sense laws of Nature, whose obligation, operation, and effect are all in the constitution and course of things. Hence it is that so much was capable of being conveyed in the form of parable—the common actions and occurrences of daily life being often chosen as the best vehicle and illustration of the highest spiritual truths. It is not merely, as Jeremy Taylor says, that "all things are full of such resemblances"—it is more than this—more than resemblance. It is the perpetual recurrence, under infinite varieties of application, of the same rules and principles of divine government—of the same divine thoughts, divine purposes, divine affections. Hence it is that no verbal definitions or logical forms can convey religious truth with the fulness or accuracy which belongs to narratives taken from Nature—man's nature and life being, of course, included in the term:

"And so, the Word had breath, and wrought
With human hands the Creed of creeds."
TENNYSON *In Memoriam.*

—ARGYLL *Reign of Law*, ch. 1, p. 32. (Burt.)

743. DECAY OF SPIRITUAL FACULTIES—*Moral Parasites.*—So far from ministering to growth, parasitism ministers to decay. So far from ministering to holiness, that is to wholeness, parasitism ministers to exactly the opposite. One by one the spiritual faculties droop and die, one by one from lack of exercise the muscles of the soul grow weak and flaccid, one by one the moral activities cease. So from him that hath not

is taken away that which he hath, and after a few years of parasitism there is nothing left to save.—DRUMMOND *Natural Law in the Spiritual World*, essay 9, p. 302. (H. AI.)

744. DECIMALS, THE SYSTEM OF, PROVIDED FOR IN CARBONIFEROUS PERIOD—*Numerical Relations in Nature.*—The leaves of plants are not arranged at random, but in a series of curiously related spirals, differing in different plants, but always the same in the same species and regulated by definite laws. Similar definiteness regulates the ramification of plants, which depends primarily on the arrangement of the leaves. The angle of ramification of the veins of the leaf is settled for each species of plant: so are the numbers of parts in the flower and the angular arrangement of these parts. It is the same in the animal kingdom, such numbers as 5, 6, 8, 10 being selected to determine the parts in particular animals and portions of animals. Once settled, these numbers are wonderfully permanent in geological time. The first known land reptiles appear in the Carboniferous period, and they have normally five toes; these appear in the earliest known species in the lowest beds of the Carboniferous. Their predecessors, the fishes, had numerous fin-rays; but when limbs for locomotion on land were contrived, the number five was adopted as the typical one. It still persists in the five toes and fingers of man himself. From these, as is well known, our decimal notation is derived. It did not originate in any special fitness of the number ten, but in the fact that men began to reckon by counting their ten fingers. Thus the decimal system of arithmetic, with all that follows from it, was settled millions of years ago, in the Carboniferous period, either by certain low-browed and unintelligent batrachians or by their Maker.—DAWSON *Facts and Fancies in Modern Science*, lect. 5, p. 184. (A. B. P. S.)

745. DECISION TO BE MADE HABITUAL—*Habit of Indecision To Be Avoided—Make Nervous System an Ally, Not an Enemy.*—The great thing, then, in all education, is to make our nervous system our ally instead of our enemy. It is to fund and capitalize our acquisitions, and live at ease upon the interest of the fund. For this we must make automatic and habitual, as early as possible, as many useful actions as we can, and guard against the growing into ways that are likely to be disadvantageous to us, as we should guard against the plague. The more of the details of our daily life we can hand over to the effortless custody of automatism, the more our higher powers of mind will be set free for their own proper work. There is no more miserable human being than one in whom nothing is habitual but indecision, and for whom . . . the drinking of every cup, the time of rising and going to bed every day, and the beginning of every bit of work, are subjects of express volitional deliberation. Full half the time of such a man goes to the deciding, or regretting, of matters which ought to be so ingrained in him as practically not to exist for his consciousness at all. If there be such daily duties not yet ingrained in any one of my readers, let him begin this very hour to set the matter right.—JAMES *Psychology*, vol. i, ch. 4, p. 122. (H. H. & Co., 1899.)

746. DECLINE OF CIVILIZATION—*Better Implements Converted into Poorer to Suit a Lower Grade of Workers.*—There is an instructive lesson to be learned from a remark made by an Englishman at Singapore, who noticed with surprise two curious trades flourishing there. One was to buy old English-built ships, cut them down, and rig them as junks; the other was to buy English percussion-muskets and turn them into old-fashioned flintlocks. At first sight this looks like mere stupidity, but on consideration it is seen to be reasonable enough. It was so difficult to get Eastern sailors to work ships of European rig that it answered better to provide them with the clumsier craft they were used to; and as for the guns, the hunters far away in the hot, damp forests were better off with gun-flints than if they had to carry and keep dry a stock of caps. In both cases, what they wanted was not the highest product of civilization, but something suited to the situation and easiest to be had. Now the same rule applies both to taking in new civilization and keeping up old. When the life of a people is altered by emigration into a new country, or by war and distress at home, or mixture with a lower race, the culture of their forefathers may be no longer needed or possible, and so dwindles away.—TYLOR *Anthropology*, ch. 1, p. 19. (A., 1899.)

747. DECOMPOSITION, BACTERIA OF—*Cycle of Building Up and Breaking Down.*—It is clear that there is in all animal life a double process continually going on; there is a building up (anabolism, assimilation), and there is a breaking down (katabolism, dissimilation). These processes will not balance each other throughout the whole period of animal life. We have, as possibilities, elaboration, balance, degeneration; and the products of animal life will differ in degree and in substance according to which period is in the predominance. These products we may subdivide simply into excretions during life and final materials of dissolution after death, both of which may be used more or less immediately by other forms of animal or vegetable life, or mediately after having passed to the soil. . . . The carbonic acid, water, and other simple substances like them will return to Nature and be of immediate use to vegetable life. But otherwise the cycle cannot be completed, for the more complex bodies are of no service as such to plants or animals. In order that this complex material should be of

service in the economy of Nature, and its constituents not lost, it is necessary that it should be broken down again into simpler conditions. This prodigious task is accomplished by the agency of two groups of organisms, the decomposition and denitrifying bacteria [*i. e.*, bacteria that reduce nitrates].—NEWMAN *Bacteria*, ch. 5, p. 148. (G. P. P., 1899.)

748. ——— ——— *Extensive Group of Saprophytes in Soil.* — This group [the saprophytic bacteria in soil] of micro-organisms is by far the most abundant as regards number. They live on the dead organic matter of the soil, and their function appears to be to break it down into simpler constitution. Specialization is probably progressing among them, for their name is legion, and the struggle for existence keen. After we have eliminated the economic bacteria, most of which are obviously saprophytes, the group is greatly reduced. . . . At present the decomposition, denitrifying, nitrifying, and nitrogen-fixing organisms are the only saprophytes which have been rescued from the oblivion of ages, and brought more or less into daylight. It is but our lack of knowledge which requires the present division of saprophytes whose business and place in the world is unknown.—NEWMAN *Bacteria*, ch. 5, p. 166. (G. P. P., 1899.)

749. DEFENSE OF PLANT AGAINST USELESS INSECTS—*Protection Varied with Situation.*—*Polygonum amphibium* is a very interesting case. The small rosy flowers are richly supplied with honey; but from the structure of the flower, it would not be fertilized by creeping insects [but only by winged insects]. As its name indicates, this plant grows sometimes on land, sometimes in water. Those individuals, however, which grow on dry land are covered by innumerable glandular viscid hairs, which constitute an effectual protection. On the other hand, the individuals which grow in water are protected by their situation. To them the glandular hairs would be useless, and in fact on such specimens they are not developed.—AVEBURY *Ants, Bees, and Wasps*, ch. 3, p. 56. (A., 1900.)

750. DEFINITIONS OF GOD—*Conspicuous Failure of Theology (Is. xl, 18, 25)*—*Primeval Conceptions Likely To Be as True.*—Professor Max Müller is disposed to deprecate the supposition that the "Heaven-Father" of the earliest Vedic hymns is rightly to be understood as having meant "what we mean by God." Very probably indeed it may have meant something much more simple. But not the less on that account it may have meant something quite as true. I do not know, indeed, why we should set any very high estimate on the success which has attended the most learned theologians in giving anything like form or substance to our conceptions of the Godhead. Christianity solves the difficulty by presenting, as the type of all true conceptions on the subject, the image of a Divine Humanity, and the history of a perfect life. . . . When we come to the abstract definitions of subsequent theology, they invariably end either in self-contradictions or in words in which beauty of rhythm takes the place of intelligible meaning. . . . I do not know, therefore, by what title we are to assume that "what we mean by God" is certainly so much nearer the truth than the simplest conceptions of a primeval age.—ARGYLL *Unity of Nature*, ch. 12, p. 300. (Burt.)

751. DEGENERACY BEYOND POWER OF RECOVERY—*Civilization Blights and Destroys*—*Decline of American Indians before White Man's Advent.*—It is another symptom of a wrong development being the real secret of their [the savages'] condition that the lowest of them seem to have lost even the power to rise. Tho individually capable of learning what civilized men have taught them, yet as races they have been invariably scorched by the light of civilization, and have withered before it like a plant whose roots have failed. The power of assimilation seems to have departed, as it always does depart from an organism which is worn out. This has not been the result with races which, tho very barbarous, have never sunk below the pastoral or the agricultural stage. It is remarkable that the Indian races of North America are perhaps the highest which have exhibited this fatal and irredeemable incapacity to rise: and it is precisely in their case that we have the most direct evidence of degradation by development in a wrong direction. There are abundant remains of a very ancient American civilization, which was marked by the construction of great public works and by the development of an agriculture founded on the maize, which is a cereal indigenous to the continent of America. This civilization was subsequently destroyed or lost, and then succeeded a period in which man relapsed into partial barbarism. The spots which had been first forest, then, perhaps, sacred monuments, and thirdly, cultivated ground, relapsed into forest once more. So strong is this evidence of degradation having affected the population of a great part of the American continent, that the distinguished author [Avebury, in "Prehistoric Times"] from whom these words are quoted, and who generally represents the savage as the nearest living representative of primeval man, is obliged to ask, "What fatal cause destroyed this earlier civilization? Why were these fortifications forsaken—these cities in ruins? How were the populous nations which once inhabited the rich American valleys reduced to the poor tribes of savages whom the European found there? Did the North and South once before rise up in arms against one another? Did the terrible appellation, the 'Dark and Bloody Land,' applied to Kentucky, commemorate these ancient wars?" Whatever may have been the

original cause, the process of degradation has been going on within the historic period. When Europeans first came in contact with the Indian tribes, there was more agriculture among them than there is now. They have long descended to the condition of pure hunters. The most fundamental of all the elements of a civilized and settled life—the love and practise of agriculture—has been lost. Development in the wrong direction had done its work.—ARGYLL *Unity of Nature*, ch. 10, p. 253. (Burt.)

752. DEGENERACY CONCEALED—*Blind Crustacea of Mammoth Cave Have Perfect External Eyes—The Internal Organ Ruined—Like Decay in Moral Realm.*—When one examines the little crustacea which have inhabited for centuries the lakes of the Mammoth Cave of Kentucky, one is at first astonished to find these animals apparently endowed with perfect eyes. The pallor of the head is broken by two black pigment specks, conspicuous indeed as the only bits of color on the whole blanched body; and these, even to the casual observer, certainly represent well-defined organs of vision. But what do they with eyes in these Stygian waters? There reigns an everlasting night. Is the law for once at fault? A swift incision with the scalpel, a glance with a lens, and their secret is betrayed. The eyes are a mockery. Externally they are organs of vision—the front of the eye is perfect; behind, there is nothing but a mass of ruins. The optic nerve is a shrunken, atrophied, and insensate thread. These animals have organs of vision, and yet they have no vision. They have eyes, but they see not. . . . The soul undergoing degeneration . . . possesses the power of absolute secrecy. When all within is festering decay and rottenness, a Judas, without anomaly, may kiss his Lord. This invisible consumption, like its fell analogue in the natural world, may even keep its victim beautiful while slowly slaying it. Exactly what Christ said of men [Matt. xiii. 14, 15].—DRUMMOND *Natural Law in the Spiritual World*, essay 2, p. 101. (H. Al.)

753. DEGENERACY DUE TO REASON—*False Reasoning Produces Unnatural Vices—Evolution of Degradation.*—The gift of reason is the very gift by means of which error in belief, and vice in character, are carried from one stage of development to another, until at last they may, and they often do, result in conditions of life and conduct removed by an immeasurable distance from those which are in accordance with the order and with the analogies of Nature. These are the conditions of life, very much lower, as we have seen, than those which prevail among the brutes, which it is now the fashion to assume to be the nearest type of the conditions from which the human race began its course. They are, in reality and on the contrary, conditions which could not possibly have been reached except after a very long journey. They are the goal at which men have arrived after running for many generations in a wrong direction. They are the result of evolution—they are the product of development. But it is the evolution of germs whose growth is noxious.—ARGYLL *Unity of Nature*, ch. 10, p. 262. (Burt.)

754. DEGENERATION FROM DISUSE—*Eyes and Wings.*—It is clear that degeneration as a result of disuse can only take place in an organ the activity of which depends upon its exercise, so that a real effect is produced by the discharge of function. The act of seeing involves certain chemical changes in the retina of the eye, and perhaps even in the optic nerve, processes which do not take place when the eye is no longer exposed to light. Flying involves metabolism in the muscles which move the wings, and this also ceases when flight is at an end. So that an actual retrogressive influence is exerted on certain parts of the eye and on the muscles by disuse.—WEISMANN *Heredity*, vol. ii, p. 18. (Cl. P., 1892.)

755. ——— ——— *Inaction—Self-supporting Organs of Parasites Perish—Ease the Ruin of Man and Nations.*—"Any new set of conditions," says Ray Lankester, "occurring to an animal which render its food and safety very easily attained seems to lead as a rule to degeneration; just as an active healthy man sometimes degenerates when he becomes suddenly possessed of a fortune; or as Rome degenerated when possessed of the riches of the ancient world. The habit of parasitism clearly acts upon animal organization in this way. Let the parasitic life once be secured, and away go legs, jaws, eyes, and ears; the active, highly gifted crab, insect, or annelid may become a mere sac, absorbing nourishment and laying eggs."—DRUMMOND *Natural Law in the Spiritual World*, essay 10, p. 310. (H. Al.)

756. DELIBERATION AND CHOICE FUNCTIONS OF CEREBRUM—*Prudence a Virtue in Higher Animals—Few of Their Acts Mechanical.*—No animal without it [the cerebrum or higher brain] can deliberate, pause, postpone, nicely weigh one motive against another, or compare. Prudence, in a word, is for such a creature an impossible virtue. Accordingly we see that Nature removes those functions in the exercise of which prudence is a virtue from the lower centers and hands them over to the cerebrum. Wherever a creature has to deal with complex features of the environment, prudence is a virtue. The higher animals have so to deal; and the more complex the features, the higher we call the animals. The fewer of his acts, then, can such an animal perform without the help of the organs in question. In the frog many acts devolve wholly on the lower centers; in the bird

fewer; in the rodent fewer still; in the dog very few indeed; and in apes and men hardly any at all.—JAMES *Psychology*, vol. i, ch. 2, p. 21. (H. H. & Co., 1899.)

757. DELICACY OF ADJUSTMENT—*Rostellum of Orchid Set Like a Hair-trigger.*—To show how delicate a touch suffices to cause the rostellum [of the *Listera ovata*] to explode, I may mention that I found an extremely minute hymenopterous insect vainly struggling to escape, with its head cemented by the hardened viscid matter to the crest of the rostellum and to the tips of the pollinia. The insect was not so large as one of the pollinia, and after causing the explosion had not strength enough to remove them; it was thus punished for attempting a work beyond its strength, and perished miserably. [A larger insect would have carried away the adhering pollen to drop it on the stigma of another flower.]—DARWIN *Fertilization of Orchids*, ch. 4, p. 120. (A., 1898.)

758. DELICACY OF ORGANIC STRUCTURE—*Vibrations Caught by Eye and Ear.*—All the organs of sense discharge their functions in virtue of a purely mechanical adjustment between the structure of the organ and the particular form of external force which it is intended to receive and to transmit. How fine those adjustments are can best be understood when we remember that the retina of the eye is a machine which measures and distinguishes between vibrations which are now known to differ from each other by only a few millionths of an inch. Yet this amount of difference is recorded and made instantly appreciable in the sensations of color by the adjusted mechanism of the eye. Another adjustment, precisely the same in principle, between the vibrations of sound and the structure of the ear, enables those vibrations to be similarly distinguished in another special form of the manifold language of sensation. And so of all the other organs of sense—they all perform their work in virtue of that purely mechanical adjustment which places them in a given relation to certain selected manifestations of external force, and these they faithfully transmit, according to a code of signals the nature of which is one of the primary mysteries of life, but the truthfulness of which is at the same time one of the most certain of its facts.—ARGYLL *Unity of Nature*, p. 37. (Burt.)

759. DELIVERER BECOMES A SCOURGE—*The Pharaoh Rat: His Uses and Abuses.*—A dozen years ago the rats multiplied superabundantly in the sugar plantations of Jamaica, where they gnawed the stalks, sucked the sap from the incision, and as soon as they had determined the fall of one cane abandoned it for another. This manner of operating had entailed a considerable loss upon the planters, and they concluded to exterminate the rats with energy. For this purpose, . . . six ichneumons were imported from India (*Herpestes ichneumon*, or Pharoah's rat, a kind peculiar to Egypt, Palestine, and Tunis). This species is the hereditary enemy of rats and serpents, so that, multiplying rapidly, they soon cleared the devourers from the plantations. The rats then invaded the farms and the villages, but were pursued there also by the ichneumons, destroying them as well as their offspring in the nests. . . . As for the ichneumons, so useful on their arrival, no longer having rats to devour, they then began to turn up in the poultry-yards, where they destroyed the eggs and young chickens; they have also totally exterminated the quail and the partridge of the island, whose eggs, deposited upon the ground, are an easy prey. They empty the eggs by making in each a tiny hole, and the ignorant mother bird continues to cover the sterile eggs. The Jamaicans, delivered from the rats by Pharoah's rat, are now seeking a new animal to deliver them from their deliverers.—*Revue des Sciences Naturelles Appliquées*, p. 960, 1890. (Translated for *Scientific Side-Lights.*)

760. DELTA OF THE MISSISSIPPI, ANTIQUITY OF—*Vast Time Required for Deposition.*—When I visited New Orleans, in February, 1846, I found that Dr. Riddell had made numerous experiments to ascertain the proportion of sediment contained in the waters of the Mississippi; and he concluded that the mean annual amount of solid matter was to the water as $\frac{1}{1245}$ in weight, or about $\frac{1}{3000}$ in volume. From the observations of the same gentleman, and those of Dr. Carpenter and Mr. Forshey, . . . the average width, depth, and velocity of the Mississippi, and thence the mean annual discharge of water, were deduced. I assumed 528 feet, or the tenth of a mile, as the probable thickness of the deposit of mud and sand in the delta: founding my conjecture chiefly on the depth of the Gulf of Mexico, between the southern point of Florida and the Belize, which equals on an average 100 fathoms, and partly on some borings 600 feet deep in the delta, near Lake Pontchartrain, north of New Orleans, in which the bottom of the alluvial matter is said not to have been reached. The area of the delta being about 13,600 square statute miles, and the quantity of solid matter annually brought down by the river 3,702,758,400 cubic feet, it must have taken 67,000 years for the formation of the whole: and if the alluvial matter of the plain above be 264 feet deep, or half that of the delta, it must have required 33,500 more years for its accumulation, even if its area be estimated as only equal to that of the delta, whereas it is in fact larger. If some deduction be made from the time here stated, in consequence of the effect of the driftwood, which must have aided in filling up more rapidly the space above alluded to, a far more important allowance must be made, on the other hand, for the loss of matter, owing to the finer

particles of mud not settling at the mouths of the river, but being swept out far to sea during the predominant action of the tides and the waves in the winter months, when the current of fresh water is feeble. Yet, however vast the time during which the Mississippi has been transporting its earthy burden to the ocean, the whole period, tho far exceeding, perhaps, 100,000 years, must be insignificant in a geological point of view, since the bluffs or cliffs bounding the great valley, and therefore older in date, and which are from 50 to 250 feet in perpendicular height, consist in great part of loam containing land, fluviatile, and lacustrine shells of species still inhabiting the same country.—LYELL *Principles of Geology,* bk. ii, ch. 18, p. 273. (A., 1854.)

761. DELUGES, ANCIENT TRADITIONS OF—*Floods of Ogyges and Deucalion.*—The traditions which have come down to us from remote ages of great inundations, said to have happened in Greece and on the confines of the Grecian settlements, had doubtless their origin in a series of local catastrophes, caused principally by earthquakes. The frequent migrations of the earlier inhabitants, and the total want of written annals long after the first settlement of each country, make it impossible for us at this distance of time to fix either the true localities or probable dates of these events. The first philosophical writers of Greece were, therefore, as much at a loss as ourselves to offer a reasonable conjecture on these points, or to decide how many catastrophes might sometimes have become confounded in one tale, or how much this tale may have been amplified, in after times, or obscured by mythological fiction. The floods of Ogyges and Deucalion are commonly said to have happened before the Trojan war; that of Ogyges more than seventeen and that of Deucalion more than fifteen centuries before our era. As to the Ogygian flood, it is generally described as having laid waste Attica, and was referred by some writers to a great overflowing of rivers, to which cause Aristotle also attributed the deluge of Deucalion, which, he says, affected Hellas only, or the central part of Thessaly. Others imagined the same event to have been due to an earthquake, which drew down masses of rock, and stopped up the course of the Peneus in the narrow defile between mounts Ossa and Olympus.—LYELL *Principles of Geology,* bk. ii, ch. 22, p. 356. (A., 1854.)

762. DELUSION BY SYSTEM—*Logic Disregarding Fact.*—Yet the essential and fundamental error of this [former medical] system was, and still continued to be, the false kind of logical conclusion to which it was supposed to lead; the conception that it must be possible to build a complete system which would embrace all forms of disease, and their cure, upon any one simple explanation.—HELMHOLTZ *Popular Lectures,* lect. 1, p. 212. (L. G. & Co., 1898.)

763. DELUSIONS BENEFICENT—*Alchemy Led to Chemistry—Greatness in Spite of Errors.*—Albertus Magnus, of the family of the Counts of Bollstädt, must be mentioned as an independent observer in the domain of analytic chemistry. It is true that his hopes were directed to the transmutation of the metals, but in his attempts to fulfil this object he not only improved the practical manipulation of ores, but he also enlarged the insight of men into the general mode of action of the chemical forces of Nature. His works contain some extremely acute observations on the organic structure and physiology of plants. He was acquainted with the sleep of plants, the periodical opening and closing of flowers, the diminution of the sap during evaporation from the surfaces of leaves, and with the influence of the distribution of the vascular bundles on the indentations of the leaves. . . . In his own observations, we, however, unhappily too often find that Albertus Magnus shared in the uncritical spirit of his age. He thinks he knows "that rye changes on a good soil into wheat; that from a beech-wood which has been hewn down a birch-wood will spring up from the decayed matter; and that from oak branches stuck into the earth vines arise." . . . The work of Albertus Magnus, entitled "Liber Cosmographicus de Natura Locorum," is a kind of physical geography. I have found in it observations which greatly excited my surprise, regarding the simultaneous dependence of climate on latitude and elevation, and the effect of different angles of incidence of the sun's rays in heating the earth's surface.—HUMBOLDT *Cosmos,* vol. ii, pt. ii, pp. 243-4. (H., 1897.)

764. ——— ——— *Columbus Aided by Ancient Medieval Error—Ocean Supposed Less than Land.*—In the present condition of the surface of our planet, the area of the solid is to that of the fluid parts as 1:2$\frac{4}{5}$ths (according to Rigaud, as 100:270). The islands form scarcely $\frac{1}{23}$d of the continental masses, which are so unequally divided that they consist of three times more land in the northern than in the southern hemisphere, the latter being, therefore, preeminently oceanic. . . . When we consider that nearly three-fourths of the upper surface of our planet are covered with water, we shall be less surprised at the imperfect condition of meteorology before the beginning of the present century. . . . In the Middle Ages the opinion prevailed that the sea covered only one-seventh of the surface of the globe, an opinion which Cardinal d'Ailly ("Imago Mundi," cap. 8) founded on the fourth apocryphal book of Esdras. Columbus, who derived a great portion of his cosmographical knowledge from the cardinal's work, was much interested in uphold-

ing this idea of the smallness of the sea, to which the misunderstood expression of "the ocean stream" contributed not a little.—HUMBOLDT *Cosmos*, vol. i, pp. 288-9. (H., 1897.)

765. DELUSIONS DUE TO NATURAL CAUSES—*Cause of Mirage—Reflection from a Surface of Heated Air.*—Total reflection never occurs except in the attempted passage of a ray from a more refracting to a less refracting medium; but in this case, when the obliquity is sufficient, it always occurs. The mirage of the desert, and other phantasmal appearances in the atmosphere, are in part due to it. When, for example, the sun heats an expanse of sand, the layer of air in contact with the sand becomes lighter and less refracting than the air above it; consequently, the rays from a distant object, striking very obliquely on the surface of the heated stratum, are sometimes totally reflected upwards, thus producing images similar to those produced by water. I have seen the image of a rock called Mont Tombeline distinctly reflected from the heated air of the strand of Normandy near Avranches; and by such delusive appearances the thirsty soldiers of the French army in Egypt were greatly tantalized.—TYNDALL *Lectures on Light,* lect. 1. p. 19. (A., 1898.)

766. DEMOCRACY AND ARISTOCRACY AS AFFECTING SCHOLARLY PURSUITS—*Social Permanence Favors Study of Pure Science.*—In a work published in 1850, De Tocqueville says: "It must be confessed that, among the civilized peoples of our age, there are few in which the highest sciences have made so little progress as in the United States." He declares his conviction that, had you been alone in the universe, you would soon have discovered that you cannot long make progress in practical science without cultivating theoretic science at the same time. But, according to De Tocqueville, you are not thus alone. He refuses to separate America from its ancestral home; and it is there, he contends, that you collect the treasures of the intellect without taking the trouble to create them. De Tocqueville evidently doubts the capacity of a democracy to foster genius as it was fostered in the ancient aristocracies. "The future," he says, "will prove whether the passion for profound knowledge, so rare and so fruitful, can be born and developed so readily in democratic societies as in aristocracies. As for me," he continues, "I can hardly believe it." He speaks of the unquiet feverishness of democratic communities, not in times of great excitement, for such times may give an extraordinary impetus to ideas, but in times of peace. There is then, he says, "a small and uncomfortable agitation, a sort of incessant attrition of man against man, which troubles and distracts the mind without imparting to it either loftiness or animation."—TYNDALL *Lectures on Light,* p. 225. (A., 1898.)

767. DEMONSTRATION DEFINED—*Circumstantial Evidence May Have Equal Force.*—What we call "demonstration" rests entirely upon our mental inability to accept as true anything that contravenes the thing affirmed; and if, in a chain of demonstrative reasoning, every link has the strength of a necessary truth, we accept its conclusion as having the same validity as the datum from which it started. Now, I hold that exactly the same state of "conviction" may be produced by a concurrence of probabilities, if these point separately and independently to the same conclusion—like radial lines that converge from different parts of the circumference of a circle, tho none actually reach its center. For the result of that concurrence may be as irresistibly probative as any demonstration; the conclusion to which they all point being one which we are compelled to accept by our inability to conceive of any other explanation of the whole aggregate of evidentiary facts, tho any one of them may be otherwise accounted for. I am not aware that this principle has been discussed in any treatise on logic; but it is familiar to every lawyer who practises in courts of justice, and its validity cannot, I think, be questioned by any one who has studied the theory of what is commonly called "circumstantial" evidence. Indeed, it would be difficult to adduce a more remarkable example of the stability of an argument erected on a broad basis of independent probabilities than is presented in the wonderful fabric built up by the genius of Darwin; the general acceptance of the evolution doctrine resting on exactly the same kind of evidence as that on which I base the argument from design.—CARPENTER *Nature and Man,* lect. 15, p. 415. (A., 1889.)

768. DENIAL OF THEOLOGY NOT ABANDONMENT OF RELIGION—*Religious Habit of Mind as a Survival.*—Sects or individuals, who have come to reject all definite theological conceptions and to deny the existence of a living God, have, nevertheless, been able to retain feelings and sentiments which may justly claim to be called religious. In the first place, with many men of this kind, their denial of a God is not in reality a complete denial. What they deny is very often only some particular conception of the Godhead, which is involved, or which they think is involved, in the popular theology. They are repelled, perhaps, by the familiarity with which the least elevated of human passions are sometimes attributed to the Divine Being. Or they may be puzzled by the anomalies of Nature, and find it impossible to reconcile them intellectually with any definite conception of a Being who is both all-powerful and all-good. But in faltering under this difficulty, or under other difficulties of the same kind, and denying the possibility of forming any clear or definite conceptions of the Godhead, they do not necessarily renounce other conceptions which,

tho vague and indefinite, are nevertheless sufficient to form the nucleus of a hazy atmosphere of religious feeling and emotion. Such men may or may not recognize the fact that these feelings and emotions have been inherited from ancestors whose beliefs were purely theological, and that it is in the highest degree doubtful how long these feelings can be retained as mere survivals.—ARGYLL *Unity of Nature*, ch. 11, p. 269. (Burt.)

769. DENSITY OF SUN RELATIVELY SLIGHT—*Contraction and Evolution of Heat Must Still Go On.*—And the sun is by no means so dense as it may become. Spectrum analysis demonstrates the presence of large masses of iron and of other known constituents of the rocks. The pressure which endeavors to condense the interior is about 800 times as great as that in the center of the earth; and yet the density of the sun, owing probably to its enormous temperature, is less than a quarter of the mean density of the earth.—HELMHOLTZ *Popular Lectures*, lect. 4, p. 182. (L. G. & Co., 1898.)

770. DEPARTMENTS OF MEMORY—*Interest and Habit Control Remembrance.*—The visual, the tactile, the muscular, the auditory memory may all vary independently of each other in the same individual; and different individuals may have them developed in different degrees. As a rule, a man's memory is good in the departments in which his interest is strong; but those departments are apt to be those in which his discriminative sensibility is high. A man with a bad ear is not likely to have practically a good musical memory, or a purblind person to remember visual appearances well. [When we consider the differences in the power of imagination in different men] it is obvious that the machinery of memory must be largely determined thereby.—JAMES *Psychology*, vol. i, ch. 16, p. 684. (H. H. & Co., 1899.)

771. DEPENDENCE, INSTINCTIVE, OF INSECT ON PROTECTIVE MIMICRY—*A Leaflike Locust.*—To show how perfect is the protection obtained [by protective mimicry] and how important it is to the possessors of it, the following incident, observed by Mr. Belt in Nicaragua, is most instructive. Describing the armies of foraging ants in the forest which devour every insect they can catch, he says: "I was much surprised with the behavior of a green leaflike locust. This insect stood immovably among a host of ants, many of which ran over its legs without ever discovering there was food within their reach. So fixed was its instinctive knowledge that its safety depended on its immovability, that it allowed me to pick it up and replace it among the ants without making a single effort to escape. This species closely resembles a green leaf."—WALLACE *Darwinism*, ch. 8, p. 138. (Hum.)

772. DEPENDENCE OF ORGANISM ON ENVIRONMENT—*Of Soul on God.*—Powerlessness is the normal state . . . of every organism apart from its environment. The entire dependence of the soul upon God is not an exceptional mystery, nor is man's helplessness an arbitrary and unprecedented phenomenon. It is the law of all Nature. . . . But who will not rather approve the arrangement by which man in his creatural life may have unbroken access to an Infinite Power? What soul will seek to remain self-luminous when it knows that "The Lord God is a sun"? Who will not willingly exchange his shallow vessel for Christ's well of living water? Even if, the organism, launched into being like a ship putting out to sea, possessed a full equipment, its little store must soon come to an end. But in contact with a large and bounteous environment its supply is limitless. In every direction its resources are infinite.—DRUMMOND *Natural Law in the Spiritual World*, essay 7, pp. 241-2. (H. Al.)

773. DEPENDENCE OF SCIENCE ON MECHANICS—Scarcely less important for the practical uses of astronomy than the optical qualities of the telescope is the manner of its mounting. The most admirable performance of the optician can render but unsatisfactory service if its mechanical accessories are ill-arranged or inconvenient. Thus the astronomer is ultimately dependent upon the mechanician; and so excellently have his needs been served that the history of the ingenious contrivances by which discoveries have been prepared would supply a subject (here barely glanced at) not far inferior in extent and instruction to the history of those discoveries themselves.—CLERKE *History of Astronomy*, pt. i, ch. 6, p. 149. (Bl., 1893.)

774. DEPENDENCE OF THE GREATEST UPON THE LEAST—*Microscopic Organisms Affect the Chief Concerns of Life.*—This application of biology to life and its problems has in recent years been nowhere more marked than in the realm of bacteriology. This comparatively new science, associated with the great names of Pasteur, Koch, and Lister, furnishes indeed a stock illustration of the applicability of pure biology. Turn where we will, we shall find the work of the unseen hosts of bacteria daily claiming more and more attention from practical people. Thus biology, even when clothed in the form of microscopic cells, is coming to occupy a new place in the minds of men. "Its evolution," as Professor Patrick Geddes declares, "forms part of the general social evolution." Certainly its recent rapid development forms a remarkable feature in the practical science of our time. Not only in the diagnosis and treatment of disease, nor even in the various applications of preventive medicine, but in ever-increasing degree and sphere, microorganisms are recognized as agents of util-

ity or otherwise no longer to be ignored. They occur in our drinking water, in our milk-supply, in the air we breathe. They ripen cream and flavor butter. They purify sewage, and remove waste organic products from the land. They are the active agents in a dozen industrial fermentations. They assist in the fixation of free nitrogen, and they build up assimilable compounds. Their activity assumes innumerable phases and occupies many spheres, more frequently proving themselves beneficial than injurious. They are both economic and industrious in the best biological sense of the terms.—NEWMAN *Bacteria*, int., p. 11. (G. P. P., 1899.)

775. DEPOSIT ON DEEP-SEA FLOOR —*The Globigerina-ooze*.—The globigerina-ooze is perhaps the best known of all the different deep-sea deposits. It was discovered and first described by the officers of the American Coast Survey in 1853. It is found in great abundance in the Atlantic Ocean in regions shallower than 2,200 fathoms. . . . It is probably formed partly by the shells of the dead Foraminifera that actually live on the bottom of the ocean and partly by the shells of those that live near the surface or in intermediate depths and fall to the bottom when their lives are done.

So abundant are the shells of these Protozoa that nearly 95 per cent. of the globigerina-ooze is composed of carbonate of lime.—HICKSON *Fauna of the Deep Sea*, ch. 2, p. 37. (A., 1894.)

776. ——— ——— *The Red Mud.*—Of all the deep-sea deposits, however, the so-called "red mud" has by far the widest distribution. It is supposed to extend over one-third of the earth's surface. It is essentially a deep-sea deposit, and one that is found in its typical condition at some considerable distance from continental land. . . . To the touch it is plastic and greasy when fresh, but it soon hardens into solid masses. When examined with the microscope it is seen to be composed of extremely minute fragments rarely exceeding 0.05 mm. in diameter. It contains a large amount of free silica that is probably formed by the destruction of numerous siliceous skeletons, and a small proportion of silicate of alumina.—HICKSON *Fauna of the Deep Sea*, ch. 2, p. 39. (A., 1894.)

777. DEPOSITS, MODERN, LIKE ANCIENT—*Strata Forming Now—Land-building under Sea*.—For more than two centuries the shelly strata of the Subapenine hills afforded matter of speculation to the early geologists of Italy, and few of them had any suspicion that similar deposits were then forming in the neighboring sea. They were as unconscious of the continued action of causes still producing similar effects as the astronomers, in the case above supposed, of the existence of certain heavenly bodies still giving and reflecting light, and performing their movements as of old. Some imagined that the strata, so rich in organic remains, instead of being due to secondary agents, had been so created in the beginning of things by the fiat of the Almighty. Others, as we have seen, ascribed the embedded fossil bodies to some plastic power which resided in the earth in the early ages of the world. In what manner were these dogmas at length exploded? The fossil relics were carefully compared with their living analogues, and all doubts as to their organic origin were eventually dispelled. So, also, in regard to the nature of the containing beds of mud, sand, and limestone: those parts of the bottom of the sea were examined where shells are now becoming annually entombed in new deposits. Donati explored the bed of the Adriatic, and found the closest resemblance between the strata there forming and those which constituted hills above a thousand feet high in various parts of the Italian peninsula. He ascertained by dredging that living testacea were there grouped together in precisely the same manner as were their fossil analogues in the inland strata; and while some of the recent shells of the Adriatic were becoming incrusted with calcareous rock, he observed that others had been newly buried in sand and clay, precisely as fossil shells occur in the Subapenine hills. This discovery of the identity of modern and ancient submarine operations was not made without the aid of artificial instruments, which, like the telescope, brought phenomena into view not otherwise within the sphere of human observation.—LYELL *Principles of Geology*, bk. i, ch. 5, p. 71. (A., 1854.)

778. DEPTH OF EARTHQUAKE SHOCK—*Convulsion Originates Miles below the Surface*.—The first calculations of the depth at which an earthquake originated were those made by Mallet for the Neapolitan earthquake of 1857. By means of a number of lines parallel to twenty-six angles of emergence, drawn in towards the seismic vertical, Mallet found that twenty-three of these intersected at a depth of 7¼ geographical miles. The maximum depth was 8¼ geographical miles, and the minimum depth 2¾ geographical miles. The mean depth was taken at a depth of 5¾ geographical miles where, within a range of 12,000 feet, eighteen of the wave-paths intersected the seismic vertical. The point where these wave-paths start thickest is at a depth not greater than three geographical miles, and this is considered to be the vertical depth of the focal cavity itself. For the Yokohama earthquake of 1880, from the indications of seismometers, and by other means, certain angles of emergence were obtained, leading to the conclusion that the depth of origin of that earthquake might be between 1½ and 5 miles. Possibly, perhaps, the earthquake may have originated from a fissure the vertical dimensions of which were comprised between these depths.—MILNE *Earthquakes*, ch. 11, p. 213. (A., 1899.)

779. DEPTHS OF OCEAN PAVED WITH VOLCANIC DUST *(Job xxxvi, 30)*—Recent deep-sea soundings, carried on in the "Challenger" and other vessels, have shown that the bottom of the deepest portion of the ocean, far away from the land, is covered with these volcanic materials which have been carried through the air or floated on the surface of the ocean. To these deeper parts of the ocean no sediments carried down by the rivers are borne, and the remains of calcareous organisms are, in these abysses, soon dissolved; under such conditions, therefore, almost the only material accumulating on the sea-bottom is the ubiquitous wind- and wave-borne volcanic products. These particles of volcanic dust and fragments of pumice by their disintegration give rise to a clayey material, and the oxidation of the magnetite, which all lavas contain, communicates to the mass a reddish tint. This appears to be the true origin of those masses of "red clay" which, according to recent researches, are found to cover all the deeper parts of the ocean.—JUDD *Volcanoes*, ch. 4, p. 73. (A., 1899.)

780. DESERT, PROTECTIVE COLORS IN—*Animals Take On the Tawny Hues of Sand and Rock.*—In the desert regions of the earth we find an even more general accordance of color with surroundings. The lion, the camel, and all the desert antelopes have more or less the color of the sand or rock among which they live. The Egyptian cat and the pampas-cat are sandy or earth colored. The Australian kangaroos are of similar tints, and the original color of the wild horse is supposed to have been sandy or clay colored. Birds are equally well protected by assimilative hues; the larks, quails, goatsuckers, and grouse which abound in the North-African and Asiatic deserts are all tinted or mottled so as closely to resemble the average color of the soil in the districts they inhabit.—WALLACE *Darwinism*, ch. 8, p. 131. (Hum., 1889.)

781. DESERTS TO BE TRANSFORMED—*Power, Manufacturing and Political, To Be Centered There—Utilizing the Direct Heat of the Sun.*—Future ages may see the seat of empire transferred to regions of the earth now barren and desolated under intense solar heat—countries which, for that very cause, will not improbably become the seat of mechanical and thence of political power. Whoever finds the way to make industrially useful the vast sun-power now wasted on the deserts of North Africa or the shores of the Red Sea will effect a greater change in men's affairs than any conqueror in history has done: for he will once more people those waste places with the life that swarmed there in the best days of Carthage and of old Egypt, but under another civilization, where man no longer shall worship the sun as a god, but shall have learned to make it his servant.—LANGLEY *New Astronomy*, ch. 4, p. 115. (H. M. & Co., 1896.)

782. DESIGN, APPARENT, IN SPIDER'S CAPTURE OF INSECT—When any large insect, as a grasshopper or wasp, is caught, the spider [*Epeira* of Brazil], by a dexterous movement, makes it revolve very rapidly, and at the same time emitting a band of threads from its spinners, soon envelops its prey in a case like the cocoon of a silkworm. The spider now examines the powerless victim, and gives the fatal bite on the hinder part of its thorax; then, retreating, patiently waits till the poison has taken effect. The virulence of this poison may be judged of from the fact that in half a minute I opened the mesh and found a large wasp quite lifeless.—DARWIN *Naturalist's Voyage around the World*, ch. 2, p. 36. (A., 1898.)

783. DESIGN, EVIDENCE OF—*Eye Formed by Convergence of Opposite Growths.*—Further evidence of "intelligent design" is supplied by the history of the development of any one of the highest forms of the eye, such as that of the chick *in ovo*. For it has been ascertained by the careful study of this process that the complete organ is the joint product of two distinct developmental actions, taking place in opposite directions—a growing inwards from the skin and a growing outwards from the brain: the former supplying the optical instrument for the formation of the visual picture, and the latter furnishing the nervous apparatus on which this is received, and by which its impression is conveyed to the sensorium.—CARPENTER *Nature and Man*, lect. 15, p. 430. (A., 1889.)

784. ——— *Fertilization of Orchids.*—Perhaps no illustration more striking of this principle was ever presented than in the curious volume published by Mr. Darwin on the "Fertilization of Orchids." It appears that the fertilization of almost all orchids is dependent on the transport of the pollen from one flower to another by means of insects. It appears, further, that the structure of these flowers is elaborately contrived, so as to secure the certainty and effectiveness of this operation. Mr. Darwin's work is devoted to tracing in detail what these contrivances are. To a large extent they are purely mechanical, and can be traced with as much clearness and certainty as the different parts of which a steam-engine is composed. The complication and ingenuity of these contrivances almost exceed belief. "Moth-traps and spring-guns set on these grounds" might be the motto of the orchids. There are baits to tempt the nectar-loving Lepidoptera, with rich odors exhaled at night, and lustrous colors to shine by day; there are channels of approach along which they are surely guided, so as to compel them to pass by certain spots;

there are adhesive plasters nicely adjusted to fit their proboscides, or to catch their brows; there are hair-triggers carefully set in their necessary path, communicating with explosive shells, which project the pollen-stalks with unerring aim upon their bodies. There are, in short, an infinitude of adjustments, for an idea of which I must refer my readers to Mr. Darwin's inimitable powers of observation and description—adjustments all contrived so as to secure the accurate conveyance of the pollen of the one flower to its precise destination in the structure of another.—ARGYLL *Reign of Law*, ch. 1, p. 22. (Burt.)

785. DESIGN IN EVOLUTION—*Plan Extended through Ages—Development of Bird.*—So, if we go back in thought to the origin of the race, as we can by actual observation to that of the individual, the old conception of "design" which was based on the idea of an original bird-creation does not lose any of its applicability, if we find reason to believe that the original progenitor was a protoplasmic "jelly-speck," certain of whose descendants have passed through a series of forms progressively improving in structure and capacity, and culminating in the perfected bird. We merely substitute for the idea of continuous uniform descent, that of the "progressive development" of the race, as representing the mode in which our present bird has come to be; deeming the latter the more probable, because we find it correspond with the embryonic history of every bird now existing. The original progenitor was just as "potentially" the race, whether called into existence as a protoplasmic "jelly-speck," or as a fully developed bird. And the evidences of "design," which on the doctrine of "special creations" we find in the construction of the original bird, and in the provision for the continuous propagation of its own type, we equally find in the production of the original "jelly-speck," and in the evolutionary process by which the very lowest type of organization has been progressively elevated to one of the highest. The marvelous succession of changes by which a chick is evolved from the germ-spot of the fowl's egg in the short period of two-and-twenty days assuredly does not become less worthy of our admiration if looked at as the abbreviated repetition of one which has extended continuously over millions of years.—CARPENTER *Nature and Man*, lect. 15, p. 432. (A., 1889.)

786. DESIGN IN NATURE—*Difficulties Unsolvable when We Attribute Our Thoughts to God—Limits of Human Intelligence (Is. lv, 8-9).*—We do not only acknowledge the impossibility of grasping the management of this divine wisdom on our part, but we also gladly acknowledge that when we speak of divine wisdom, of reason in Nature, of having an end in view, of a world-plan, or of an object in the world's development, we are speaking in human terms of that which, after all, is high above everything human, that we are anthropomorphizing. Whether we speak of what is conformable to a design or the part of a highest reason, or of a divine wisdom in Nature, we are in both instances speaking according to human intuitions and power of thought, of that of which we have no corresponding form, have absolutely no analogy. And he who thinks of the divine wisdom as so human that it first decides upon an object and an aim and then makes a plan, and afterwards considers the means for the attainment of this aim, and finally applies the required means, is dragging the power of the Eternal down within the limits and the changes of time. Or he who represents to himself God's management as if he were enthroned in some high place from whence he invades the world for specific purposes, now here, now there, in order to remove some disturbance, or to repair something that human beings have spoiled, he who draws the Infinite Spirit into the limits of space gets himself involved in unsolvable difficulties, into contradictions from which there is no escape.—GRAUE *Darwinismus und Sittlichkeit*, p. 65, in *Deutsche Zeit- und Streit-Fragen*, vol. viii. p. 505. (Translated for *Scientific Side-Lights.*)

787. DESIGN IN THE SEA-ANEMONE—*Coordination of Parts for Result.*—Look, for example, at a sea-anemone in the act of feeding, and see how its multiple tentacles attach themselves to a piece of fish, or to the shell of a mussel or periwinkle, and draw it by their united contraction into the creature's stomach. The adaptation is not less perfect because the action is so simple; nothing could be conceived more suitable to the conditions under which the sea-anemone lives; and the multiplication of similar parts so disposed as to enable them to work together to a common end seems to me as clear an evidence of "designed" adaptation in the sea-anemone as it is admitted to be in the "flint implement" [see DESIGN PROVES DESIGNER, 789-90].—CARPENTER *Nature and Man*, lect. 15, p. 421. (A., 1889.)

788. DESIGN IN WORK OF MEN OR BEAVERS—*Evidence of Purpose in Higher or Lower Mind.*—A dam across a stream, and the appearance of the stumps of trees which entered into its formation, would suggest design quite irrespective of and antecedent to the considerable knowledge or experience which would enable the beholder to decide whether this was the work of men or of beavers. Why, then, should the judgment that any particular structure is a designed work be thought illegitimate when attributed to a higher instead of a lower intelligence than that of man?—GRAY *Darwiniana*, art. 13, p. 364. (A., 1889.)

789. DESIGN PROVES DESIGNER—*Flint Implements—Accident Once Assigned as Their Cause—Human Origin Now Unquestioned.*—About thirty years ago [*i. e.*,

1854] we began to hear a good deal about "flint implements." They had not been altogether unknown previously, as specimens of them were to be found in museums of antiquities; but they had never been brought to light in such numbers, and under such very peculiar circumstances, as in the working of the gravel-beds of the valley of the Somme, near Abbeville and Amiens. The matter was brought into notice by M. Boucher de Perthes, a distinguished antiquarian and collector at Abbeville. English men of science went over to study the conditions under which these flint implements were found, and very soon satisfied themselves of the genuineness and importance of this discovery. There were many who at first denied that they afforded any evidence of the existence of man at the time when these gravel-beds were deposited, maintaining that their peculiar shapes had been given by accidental collisions. I do not know that any sane man now questions their human production.—CARPENTER *Nature and Man*, lect. 15, p. 416. (A., 1889.)

790. ——— ——— *Cumulative Evidence of Human Handiwork.*—If, in walking through a chalk country, you look at a heap of flints collected by the roadside for mending the road, you will find the greater part of them entire, having shapes that suggest to the naturalist the forms of the sponges, by the silicification of which they were originally produced. You will doubtless find some broken; but you will never meet with one that even remotely resembles the characteristic "flint implement" of the Amiens and Abbeville gravels. They may have one or two, or perhaps half a dozen, fractured surfaces; but these are quite irregular, having no relation one to another. Now, a "flint implement" exhibits, perhaps, fifty fractures, and they are all so related in size and position as to bring out a very definite shape. Yet this consideration alone did not by any means satisfy those who were unwilling to admit the conclusion that this shape had been worked out by human hands. I well remember that when these objects were first brought into public notice there were many persons who said, "The shaping of these flints is merely accidental: the flint fell into a river in which there were many stones knocking about, and the fractures have been produced by the flint having got, so to speak, under a number of hammers; so that, a bit having been broken away here and a bit there, it has come to be shaped as it is now found." I will not say that this is an absolutely impossible supposition with respect to any single example: but when we find numbers of these flints, all showing the same form, in one gravel-bed—when we meet with forms exactly similar in other gravel-beds—and when we learn that exactly similar flints are used at the present time by peoples (some of the hill tribes of India, for instance) among whom iron implements have not yet found their way, the implements being held in a cleft stick and bound round by a leather thong—then, I think, we have an accumulation of evidence which makes it inconceivable that these gravel-flints, of which I have spoken, owed their shape to anything else than human handiwork.—CARPENTER *Nature and Man*, lect. 15, p. 417. (A., 1889.)

791. DESIRE OF WEALTH APPROVED—*Modern in Contrast to Ancient Systems.*—Since the dissolution of the Greek and Roman commonwealths, no nation has acted on the one great error of all the ancient systems of political philosophy—that the natural desire of men for the accumulation of wealth is an evil to be dreaded and repressed. So far as this goes there is a sharp and striking contrast between the spirit of ancient and of modern policy. The great object of the ancient policy, says Dugald Stewart, "was to counteract the love of money and a taste for luxury by positive institutions, and to maintain in the great body of the people habits of frugality and a severity of manners. The decline of states is uniformly ascribed by philosophers and historians, both of Greece and Rome, to the influence of riches on national character, and the laws of Lycurgus, which, during a course of ages, banished the precious metals from Sparta, are proposed by many of them as the most perfect model of legislation devised by human wisdom. How opposite to this is the doctrine of modern politicians! Far from considering poverty as an advantage to a state, their great aim is to open new sources of national opulence, and to animate the activity of all classes of the people by a taste for the comforts and accommodations of life."—ARGYLL *Reign of Law*, ch. 7, p. 199. (Burt.)

792. DESTRUCTION, AGENTS OF——*Putrefaction an Impossibility without Bacteria.*—"No putrefaction," says Cohn ["Beiträge zur Biologie der Pflanzen," zweites Heft, 1872, p. 203], "can occur in a nitrogenous substance if it be kept free from the entrance of new bacteria after those which it may contain have been destroyed. Putrefaction begins as soon as bacteria, even in the smallest numbers, are accidentally or purposely introduced. It progresses in direct proportion to the multiplication of the bacteria; it is retarded when the bacteria (for example, by a low temperature) develop a small amount of vitality, and is brought to an end by all influences which either stop the development of the bacteria or kill them. All bactericidal media are therefore antiseptic and disinfecting."—TYNDALL *Floating Matter of the Air*, essay 2, p. 48. (A., 1895.)

793. DESTRUCTION BY INDIRECT ACTION—*Climate and Garden Plants.*—That climate acts in main part indirectly by favoring other species we clearly see in the prodigious number of plants which in our

gardens can perfectly well endure our climate, but which never become naturalized, for they cannot compete with our native plants nor resist destruction by our native animals.—DARWIN *Origin of Species*, ch. 1, p. 65. (Burt.)

794. DESTRUCTION BY MEANS USED FOR SAFETY—*Sleep Changed to Sudden Death—Mountain Flung Down upon Plain.*—The destruction of the Prince of Scilla and a great number of his vassals was one of the most remarkable events attending [the earthquake in Calabria, 1783]. He had persuaded his servants to seek their fishing-boats for safety, and went with them to encourage them. During the night of February 5, while they were sleeping, an enormous mass of earth was flung from Mount Jaci upon the plain near which the boats were moored. Immediately the sea rose more than twenty feet above the level of the plain. Every boat was sunk or dashed upon the beach, and hundreds of persons who had been sleeping on the plain were swept out to sea. The prince and 1,430 of his servants perished.—PROCTOR *Notes on Earthquakes*, p. 4. (Hum., 1887.)

795. DESTRUCTION OF AMERICA'S FORESTS—*Exhaustion of England's Coal—Sun's Direct Heat May Be Reliance of the Future.*—Your mighty forests seem capable of supplying all the timber that the whole race of man could need for ages; yet a very moderate computation of the rate at which they are being cut down, and will presumably continue to be, by a population increasing rapidly in numbers and in the destructive capabilities which characterize modern civilization, would show that America will be denuded of its forest wealth in about the same period which we in England have calculated as probably limiting the effective duration of our stores of coal. That period —a thousand or twelve hundred years—may seem long compared with the life of individual men, long even compared with the duration of any nation in the height of power; but tho men and nations pass away the human race continues, and a thousand years are as less than a day in the history of that race. . . . Either a change in their mode of civilization will be forced on the human race, or else it will then have become possible, as your Ericsson has already suggested, to make the sun's daily heat the mainspring of the machinery of civilization. —PROCTOR *Our Place among Infinities*, p. 26. (L. G. & Co.. 1897.)

796. DESTRUCTION OF ART TREASURES DEPLORED—*Wonders of Life Destroyed without Protest.*—The large avians, together with the finest of the mammalians, will shortly be lost to the pampas utterly, as the great bustard is to England and as the wild turkey and bison and many other species will shortly be lost to North America. What a wail there would be in the world if a sudden destruction were to fall on the accumulated art treasures of the National Gallery, and the marbles in the British Museum, and the contents of the King's Library—the old prints and medieval illuminations! And these are only the work of human hands and brains—impressions of individual genius on perishable material, immortal only in the sense that the silken cocoon of the dead moth is so, because they continue to exist and shine when the artist's hands and brain are dust—and man has the long day of life before him in which to do again things like these, and better than these, if there is any truth in evolution. But the forms of life in the two higher vertebrate classes are Nature's most perfect work; and the life of even a single species is of incalculably greater value to mankind, for what it teaches and would continue to teach, than all the chiseled marbles and painted canvases the world contains.—HUDSON *Naturalist in La Plata*, ch. 1, p. 28. (C. & H., 1895.)

797. DESTRUCTION OF NOXIOUS INSECTS—*Beneficial Industry of Ants.*—There are, of course, many cases in which the action of ants is very beneficial to plants. They kill off a great number of small caterpillars and other insects. Forel found in one large nest that more than twenty-eight dead insects were brought in per minute, which would give during the period of greatest energy more than 100,000 insects destroyed in a day by the inhabitants of one nest alone.—AVEBURY *Ants, Bees, and Wasps*, ch. 3, p. 59. (A., 1900.)

798. DESTRUCTION OF PLANTS BY ANIMALS—Besides this direct competition, there is one not less powerful arising from the exposure of almost all plants to destruction by animals. The buds are destroyed by birds, the leaves by caterpillars, the seeds by weevils; some insects bore into the trunk, others burrow in the twigs and leaves; slugs devour the young seedlings and the tender shoots, wireworms gnaw the roots. Herbivorous mammals devour many species bodily, while some uproot and devour the buried tubers.—WALLACE *Darwinism*, ch. 2, p. 11. (Hum., 1889.)

799. DESTRUCTION OF THE EARTH WOULD BE UNFELT IN UNIVERSE—*Like the Falling of a Leaf in the Forest.*—And what is this world in the immensity which teems with them—and what are they who occupy it? The universe at large would suffer as little, in its splendor and variety, by the destruction of our planet, as the verdure and sublime magnitude of a forest would suffer by the fall of a single leaf. The leaf quivers on the branch which supports it. It lies at the mercy of the slightest accident. A breath of wind tears it from its stem, and it lights on the stream of water which passes underneath. In a moment of time, the life which we know, by the microscope, it teems with, is extinguished; and an occurrence so insignificant in the eye

of man, and on the scale of his observation, carries in it, to the myriads which people this little leaf, an event as terrible and as decisive as the destruction of a world. Now, on the grand scale of the universe, we, the occupiers of this ball, which performs its little round among the suns and the systems that astronomy has unfolded—we may feel the same littleness, and the same insecurity. We differ from the leaf only in this circumstance, that it would require the operation of greater elements to destroy us. But these elements exist.—CHALMERS *Astronomical Discourses*, p. 37. (R. Ct., 1848.)

800. DESTRUCTION OF TREES CHANGES EARTH'S SURFACE—When traveling in Georgia, in 1846, I saw the commencement of hundreds of valleys in places where the native forest had recently been removed. One of these newly formed gullies or ravines . . . occurs on the road to Macon. Twenty years ago, before the land was cleared, it had no existence; but when the trees of the forest were cut down, cracks three feet deep were caused by the sun's heat in the clay; and, during the rains, a sudden rush of water through the principal crack deepened it at its lower extremity, from whence the excavating power worked backwards, till, in the course of twenty years, a chasm, measuring no less than 55 feet in depth, 300 yards in length, and varying in width from 20 to 180 feet, was the result. The highroad has been several times turned to avoid this cavity, the enlargement of which is still proceeding, and the old line of road may be seen to have held its course directly over what is now the wildest part of the ravine.—LYELL *Principles of Geology*, ch. 14, p. 204. (A., 1854.)

801. DESTRUCTION, VIEWLESS AGENT OF—*Frost Disintegrates Rocks and Breaks Down Mountains.*—The disintegrating action of rain in temperate and high latitudes is greatly aided by frost, and the same is the case in the elevated tracts of more southern latitudes. Rain renders the superficial portions of rock more porous, and thus enables frost to act more effectually; while frost, by widening pores and fissures, affords readier ingress to meteoric water. . . . The great heaps or "screes" of rock-rubbish which cloak the summits and slopes of our mountains, and gather thickly along the base of precipice and cliff, have been dislodged by frost and rolled down from above, their progress downward being often aided by torrential rains, melting snow, and the alternate freezing and thawing of the saturated débris itself.—GEIKIE *Earth Sculpture*, ch. 2, p. 28. (G. P. P., 1898.)

802. DEVELOPMENT DELAYED FOR A PURPOSE—*Device to Secure Cross-fertilization.*—In *Spiranthes* the young flowers, which have their pollinia in the best state for removal, cannot possibly be fertilized; they must remain in a virgin condition until they are a little older and the column has moved away from the labellum. Here the same end is gained by widely different means. The stigmas of the older flowers are more adhesive than those of the younger flowers. These latter have their pollinia ready for removal; but immediately after the rostellum has exploded it curls forwards and downwards, thus protecting the stigma for a time; but it slowly becomes straight again, and now the mature stigma is left freely exposed, ready to be fertilized [by pollen from another flower].—DARWIN *Fertilization of Orchids*, ch. 4, p. 121. (A., 1898.)

803. DEVELOPMENT FROM THE CELL—*Embryos of a Sheep, Tiger, Lizard, Bird, and Ape Indistinguishable—Each Animal Recapitulates the History of Its Race.*—Every animal or plant begins its existence as a cell, which develops by a process of repeated fission and growth into the perfect form. But if we trace the different types backward, we find that we come to a stage when the embryos of all the members of an order, such as the various species of ruminants, are indistinguishable; earlier still all the members of a class, such as the mammalia, are equally alike, so that the embryos of a sheep and a tiger would be almost identical; earlier still all vertebrates, a lizard, a bird, and a monkey, are equally indistinguishable. Thus in its progress from the cell to the perfect form every animal recapitulates, as it were, the lower forms upon its line of descent, thus affording one of the strongest indirect proofs of the theory of evolution. The earliest definite result of cell-division is to form what is termed the "gastrula," which is a sac with a narrow mouth, formed of two layers of cells. All the higher animals, without exception, from mollusk to man, go through this "gastrula" stage, which again indicates that all are descended from a common ancestral form of this general type.—WALLACE *The Wonderful Century*, ch. 14, p. 144. (D. M. & Co., 1899.)

804. DEVELOPMENT, GRADUAL—*Of Arts and Sciences—Antiquity of Egyptian and Babylonian Culture.*—On the whole it appears that wherever there are found elaborate arts, abstruse knowledge, complex institutions, these are results of gradual development from an earlier, simpler, and ruder state of life. No stage of civilization comes into existence spontaneously, but grows or is developed out of the stage before it. This is the great principle which every scholar must lay firm hold of, if he intends to understand either the world he lives in or the history of the past. Let us now see how this bears on the antiquity and early condition of mankind. The monuments of Egypt and Babylonia show that toward 5,000 years ago certain nations had already come to an advanced state of culture. No doubt the greater part of the earth was then

peopled by barbarians and savages, as it remained afterwards. But in the regions of the Nile and the Euphrates there was civilization.—Tylor *Anthropology,* ch. 1, p. 20. (A., 1899.)

805. ——— ——— *Of Culture through the Ages.*—Within the entire economy of the human race on earth, it has been found that just that which had its origin in physical needs, on further development serves ideal purposes. But before this distillation of spirit out of naturalism can take place, centuries, thousands of years, must elapse, as we observe from the history of culture in the Orient, or may perceive in any peasant village.—Humboldt, *quoted by* Goltz, *Ethnologische Studie zur Geschichte und Charakterisirung des deutschen Volkes,* p. 130. (Translated for *Scientific Side-Lights.)*

806. DEVELOPMENT MAY BE RETROGRESSIVE—*Nature Discards the Most Elaborate Structures when Disused.*—Everything that Nature has built up with such elaborate care—highly developed organs of locomotion, limbs fitted to support a certain weight, joints with their complex and yet easy movements, the exquisite balance of muscular strength required for rapid motion on the ground, wings adapted for flying, with all the marvelously adjusted organs which overcome gravity and render rising into the air a possibility, every one of the adaptations by which animals are placed in communication with the outer world which surrounds them—eyes of the most delicate and complex structure, organs of hearing and smell so wonderfully formed that it has needed long years of the combined researches of all the most eminent naturalists to understand their full significance—each one of these is relinquished, is handed over to a process of gradual destruction, the moment it ceases to be essential to the life of the species.—Weismann *Heredity,* vol. ii, ch. 9, p. 29. (Cl. P., 1897.)

807. DEVELOPMENT OF EXPERIMENTAL SCIENCE—*Greek Study Too Subjective.*—The knowledge of Nature, as it existed among the Hellenic nations under the most ancient forms of physics, was derived more from the depth of mental contemplation than from the sensuous consideration of phenomena. Thus the natural philosophy of the Ionian physiologists was directed to the fundamental ground of origin, and to the metamorphoses of one sole element, while the mathematical symbolism of the Pythagoreans, and their consideration of numbers and forms, disclose a philosophy of measure and harmony. The Doric-Italian school, by its constant search for numerical elements, and by a certain predilection for the numerical relations of space and time, laid the foundation, as it were, of the subsequent development of our experimental sciences.—Humboldt *Cosmos,* vol. ii, pt. ii, p. 108. (H., 1897.)

808. DEVELOPMENT OF INDIVIDUAL REPEATS THAT OF RACE—The history of the development of the individual is a repetition of the history of the race. That is to say, each organic being in its development repeats in brief the entire process the ancestors of the individual have passed through from the origin of the race.—Vaihinger, an address. (Translated for *Scientific Side-Lights.)*

809. DEVELOPMENT OF REPTILE INTO BIRD — *Aimless Variation Not an Explanation—Intentional Prearrangement Necessary.*—Let us grant, for the sake of argument, that all past and present modifications of the original bird type may have thus arisen [*i. e.,* by "natural selection"]. But on the mode in which that singularly specialized type came into existence—in which that most wonderful feature of its organization, the feather, arose out of the scaly covering of its reptilian ancestors—in which its heart came to be divided into four chambers instead of three, and the arrangement of its blood-vessels altered accordingly, in the establishment of the "complete double circulation," that insures the perfect aeration of the blood needed for the maintenance of the extraordinary muscular energy by which the feathered wings can sustain the body in flight—I cannot see that "natural selection" throws the least light. There is, as I have already pointed out, an adaptation in the several parts of the structure of the bird, not only to one general result, but to a consentaneous action in bringing about that result, which shows itself to be more complete the more closely it is scrutinized. And on the hypothesis of "natural selection" among "aimless" variations, I think it could be shown that the probability is infinitely small, that the progressive modifications required in the structure of each individual organ to convert a reptile into a bird, could have taken place without disturbing the required harmony in their combined action; nothing but intentional prearrangement being competent to bring about such a result. And the point on which I now wish to fix your attention is the evidence of such prearrangement that is furnished by the orderly sequence of variations allowing definite lines of advance.—Carpenter *Nature and Man,* lect. 15, p. 441. (A., 1889.)

810. DEVELOPMENT OF SCIENCE—*Advances Made in Astronomy—Earth Closer to Other Worlds.*—We stand in a position much more favorable for the formation of just views on the subject of life in other worlds than that from which men surveyed the planetary and stellar systems thirty or forty years since. Never, since men first explored the celestial depths, has a series of more startling discoveries rewarded the labors of astronomers and physicists than during the past few years. Unhoped-for revelations have been made on every side.

Analogies the most interesting have brought the distant orbs of heaven into close relationship with our own earth or with the central luminary of the planetary scheme. And a lesson has been taught us which bears even more significantly on our views respecting the existence of other worlds: we have learned to recognize within the solar system, and within the wondrous galaxy of which our sun is a constituent orb, a variety of structure and a complexity of detail of which but a few years ago astronomers had formed but the most inadequate conceptions. —PROCTOR *Other Worlds than Ours*, int., p. 19. (Burt.)

811. ——— ——— *Astronomy Historically the First of the Sciences—Next, Mechanics.*—For a time—and that historically a long one—he [man] was limited to mere observation, accepting what Nature offered, and confining intellectual action to it alone. The apparent motions of sun and stars first drew towards them the questionings of the intellect, and accordingly astronomy was the first science developed. Slowly, and with difficulty, the notion of natural forces took root in the human mind. Slowly, and with difficulty, the science of mechanics had to grow out of this notion; and slowly at last came the full application of mechanical principles to the motions of the heavenly bodies. We trace the progress of astronomy through Hipparchus and Ptolemy; and, after a long halt, through Copernicus, Galileo, Tycho Brahe, and Kepler; while from the high table-land of thought raised by these men Newton shoots upward like a peak, overlooking all others from his dominant elevation.—TYNDALL *Lectures on Light*, lect. 1, p. 4. (A., 1898.)

812. DEVELOPMENT OF SENSES AS WELL AS MUSCLES BY PRACTISE—*Possible Discrimination of Minute Differences of Sensation.*—That "practise makes perfect" is notorious in the field of motor accomplishments. But motor accomplishments depend in part on sensory discrimination. Billiard-playing, rifle-shooting, tight-rope-dancing, demand the most delicate appreciation of minute disparities of sensation, as well as the power to make accurately graduated muscular response thereto. In the purely sensorial field we have the well-known virtuosity displayed by the professional buyers and testers of various kinds of goods. One man will distinguish by taste between the upper and the lower half of a bottle of old Madeira. Another will recognize, by feeling the flour in a barrel, whether the wheat was grown in Iowa or Tennessee. The blind deaf-mute, Laura Bridgman, had so improved her touch as to recognize, after a year's interval, the hand of a person who once had shaken hers; and her sister in misfortune, Julia Brace, is said to have been employed in the Hartford Asylum to sort the linen of its multitudinous inmates, after it came from the wash, by her wonderfully educated sense of smell.—JAMES *Psychology*, vol. i, ch. 13, p. 509. (H. H. & Co., 1899.)

813. DEVELOPMENT, ORDERLY, OF UNIVERSE—*Astronomy, Geology, Zoology Allied—One Grand Movement Pervading All Sciences.*—It was not until the nineteenth century that the microscope . . . was perfected as an instrument, and accomplished for zoology its final and most important service. . . .

On the other hand, the astronomical theories of development of the solar system from a gaseous condition to its present form, put forward by Kant and by Laplace, had impressed men's minds with the conception of a general movement of spontaneous progress or development in all Nature; and, tho such ideas were not new, but are to be found in some of the ancient Greek philosophers, yet now for the first time they could be considered with a sufficient knowledge and certainty as to the facts, due to the careful observation of the two preceding centuries. The science of geology came into existence, and the whole panorama of successive stages of the earth's history, each with its distinct population of strange animals and plants, unlike those of the present day and simpler in proportion as they recede into the past, was revealed by Cuvier, Agassiz, and others. The history of the crust of the earth was explained by Lyell as due to a process of slow development, in order to effect which he called in no cataclysmal agencies, no mysterious forces differing from those operating at the present day. Thus he carried on the narrative of orderly development from the point at which it was left by Kant and Laplace—explaining by reference to the ascertained laws of physics and chemistry the configuration of the earth, its mountains and seas, its igneous and its stratified rocks, just as the astronomers had explained by those same laws the evolution of the sun and planets from diffused gaseous matter of high temperature.

The suggestion that living things must also be included in this great development was obvious.—LANKESTER *History and Scope of Zoology*, p. 7. (Hum., 1893.)

814. DEVELOPMENT, PSYCHICAL, ARRESTS PHYSICAL—*Future Progress within the Mind, Not the Body.*—Alfred Russel Wallace, the illustrious codiscoverer of natural selection, saw that along with the general development of mammalian intelligence a point must have been reached in the history of one of the primates when variations of intelligence were more profitable to him than variations in body. From that time forth that primate's intelligence went on by slow increments acquiring new capacity, while his body changed but little. When once he could strike fire, and chip a flint, and use a club, and strip off the bear's hide to cover himself, there was clearly no further use in thickening his own hide, or lengthen-

ing and sharpening his claws. Natural selection is the keenest capitalist in the universe; she never loses an instant in seizing the most profitable place for investment, and her judgment is never at fault.—FISKE *Through Nature to God,* pt. ii, ch. 5, p. 83. (H. M. & Co., 1900.)

815. DEVIATIONS INHERITABLE—The number and diversity of inheritable deviations of structure, both those of slight and those of considerable physiological importance, are endless. Dr. Prosper Lucas's treatise, in two large volumes, is the fullest and the best on this subject. No breeder doubts how strong is the tendency to inheritance; that like produces like is his fundamental belief: doubts have been thrown on this principle only by theoretical writers. [See HEREDITY OF ACQUIRED CHARACTERS.]—DARWIN *Origin of Species,* ch. 1, p. 12. (Burt.)

816. DEVICE COMMON TO DIVERSE PEOPLES—*Falcons of the Sea—A Sucking-fish as Captor of Other Fishes.*—In the time of Columbus the now desolate district of the Jardines del Rey was animated by a singular branch of industry pursued by the inhabitants of the seacoasts of Cuba, who availed themselves of a little fish, the remora, or sucking-fish (the so-called ship-holder), probably the *Echeneis naucrates,* for catching turtles. A long and strong line, made of the fibers of the palm, was attached to the tail of the fish. The remora (called in Spanish *revcs,* or reversed, because at first sight the back and abdomen might easily be mistaken for each other) attaches itself by suction to the turtle through the indented and movable cartilaginous plates of the upper shell that covers the head. The remora, says Columbus, would rather let itself be torn to pieces than relinquish its prey, and the little fish and the turtle are thus drawn out of the water together. . . . We learn from Dampier and Commerson that this artifice of employing a sucking-fish to catch other fishes is very common on the eastern coasts of Africa, near Cape Natal and Mozambique, as well as on the island of Madagascar. An acquaintance with the habits of animals, and the same necessities, lead to similar artifices and modes of capture amongst tribes having no connection with one another.—HUMBOLDT *Views of Nature,* p. 257. (Bell, 1896.)

817. DEVICES FOR EXPLAINING THE MYSTERY OF EVIL—*Comte Would Have Improved the Tilt of the Earth's Axis.*—[To explain the mystery of evil] it has usually been found necessary to represent the Creator as finite either in power or in goodness, altho the limitation is seldom avowed, except by writers who have a leaning toward atheism and take a grim pleasure in pointing out flaws in the constitution of things. Among modern writers the most conspicuous instance of this temper is afforded by that much too positive philosopher, Auguste Comte, who would fain have tipped the earth's axis at a different angle and altered the arrangements of Nature in many fanciful ways. He was like Alphonso, the learned king of Castile, who regretted that he had not been present when the world was created—he could have given such excellent advice!—FISKE *Through Nature to God,* pt. i, ch. 3, p. 12. (H. M. & Co., 1900.)

818. DEVOTION TO SCIENCE—*Von Buch Traverses Europe on Foot for Geologic Study—Unites the Aqueous and Igneous Theories.*—It was a pupil of Werner's who at last set at rest this much-vexed question [between the aqueous and the igneous origin of rocks].

At the age of sixteen, in the year 1790, Leopold von Buch was placed under Werner's care at the mining school of Freiberg. . . . Von Buch was indefatigable. For years he lived the life of an itinerant geologist. With a shirt and a pair of stockings in his pocket, and a geological hammer in his hand, he traveled all over Europe on foot. The results of his foot-journey to Scandinavia were among his most important contributions to geology. He went also to the Canary Islands; and it is in his extensive work on the geological formations of these islands that he showed conclusively not only the Plutonic character of all unstratified rocks, but also that to their action upon the stratified deposits the inequalities of the earth's surface are chiefly due. He first demonstrated that the melted masses within the earth had upheaved the materials deposited in layers upon its surface, and had thus formed the mountains.—AGASSIZ *Geological Sketches,* ser. i, ch. 4, p. 111. (H. M. & Co., 1896.)

819. DEW, FORMATION OF—*Nice Balance of Atmospheric Moisture and Temperature Provided for.*—Dew forms more readily and more abundantly on grass, on account of the numerous centers of condensation it affords. Dew, however, is now formed only on clear cold nights after warm or moist days. The air near the surface is warm and contains much vapor, tho below the point of saturation. But the innumerable points and extensive surfaces of grass radiate heat quickly, and becoming cool, lower the temperature of the adjacent air, which then reaches saturation-point and condenses the contained vapor on the grass. Hence, if the atmosphere at the earth's surface became supersaturated with aqueous vapor, dew would be continuously deposited, especially on every form of vegetation, the result being that everything, including our clothing, would be constantly dripping wet. If there were absolutely no particles of solid matter in the upper atmosphere, all the moisture would be returned to the earth in the form of dense mists, and frequent and

copious dews, which in forests would form torrents of rain by the rapid condensation on the leaves.—WALLACE *The Wonderful Century,* ch. 9, p. 78. (D. M. & Co., 1899.)

820. DIFFERENCE IN HABITS OF MALE AND FEMALE—*Mother-bird Seeks Protection in Silence.*—A scarlet-breasted troopial of La Plata perches conspicuously on a tall plant in a field, and at intervals soars up vertically, singing, and, at the highest ascending point, flight and song end in a kind of aerial somersault and vocal flourish at the same moment. Meanwhile, the dull-plumaged female is not seen and not heard: for not even a skulking crake lives in closer seclusion under the herbage—so widely have the sexes diverged in this species. Is the female, then, without an instinct so common?—has she no sudden fits of irrepressible gladness? Doubtless she has them, and manifests them down in her place of concealment in lively chirpings and quick motions—the simple, primitive form in which gladness is expressed in the class of birds. In the various species of the genus *Cnipolegus* . . . the difference in the sexes is just as great as in the case of the troopial; the solitary, intensely black, statuesque male has . . . a set and highly fantastic performance; but on more than one occasion I have seen four or five females of one species meet together and have a little simple performance all to themselves—in form a kind of lively mock-fight.—HUDSON *Naturalist in La Plata,* ch. 19, p. 283. (C. & H., 1895.)

821. DIFFERENCE IN WEARING OF ROCKS BY ICE AND BY WATER—*Nature's Distinctions also Those of Science.*—The leveling and abrading action of water on rock has an entirely different character [from glacier action]. Tides or currents driven powerfully and constantly against a rocky shore, and bringing with them hard materials, may produce blunt, smooth surfaces, such as the repeated blows of a hammer on stone would cause; but they never bring it to a high polish, because the grinding materials are not held steadily down in firm permanent contact with the rocky surfaces against which they move, as is the case with the glacier. On the contrary, being dashed to and fro, they strike and rebound, making a succession of blows, and never a continuous, uninterrupted pressure and friction. The same is true of all the marks made on rocky shores against which loose materials are driven by water-currents. They are separate, disconnected, fragmentary; whereas the lines drawn by the hard materials set in the glacier, whether light and fine or strong and deep, are continuous, often unbroken for long distances and rectilinear.—AGASSIZ *Geological Sketches,* ser. ii, p. 35. (H. M. & Co., 1896.)

822. DIFFERENCE OF DEVELOPMENT PRODUCES DIFFERENCE OF CHARACTER—*Among Bees, Workers Are But Undeveloped Queens.*—The "workers" among hive-bees are not really "neuters," but are undeveloped females; every one of them being originally a potential queen. They differ from the queen, or fertile female, however, not merely in the non-development of the reproductive organs (which shows itself in the inferior length of the abdomen), but also in the possession of the "pollen-baskets" on the thighs, which are used in the collection of pollen and propolis, and in the conformation of the jaws and antennæ. But they differ yet more in their instincts, for whilst the life-work of the queen is to lay eggs, that of the workers is to build cells for their reception, to collect and store up food, and to nurture the larvæ—this nurturing process being continued as a sort of incubation during the pupa-state. The worker-larvæ, which come forth from the eggs that are laid in ordinary cells, are fed for three days upon a peculiar substance of jellylike appearance, prepared in the stomachs of the workers; but afterwards upon "bee-bread" composed of a mixture of honey and pollen. The queen-larvæ, on the other hand, are reared in larger royal cells of peculiar construction; and they are fed during the whole of the larva-period upon the substance prepared by the workers, which is hence known as "royal jelly." The length of time occupied in their development is different; the preliminary stages of the queen being passed through in sixteen days, whilst those of the worker require twenty-one.

Now it sometimes happens that, from some causes not understood, there is a failure in the production of young queens, so that there are none forthcoming when wanted. The workers then select either worker-eggs or worker-larvæ not yet three days old, and around these they construct "royal cells," by throwing together several adjacent worker-cells and destroying the larvæ they contain. The selected larvæ are fed with the "royal jelly," and are treated in every respect as queen-larvæ; and in due time they come forth as perfect queens—thus having had not only their bodily organization, but their psychical nature, essentially altered by the nurture they have received.—CARPENTER *Mental Physiology,* ch. 2, p. 61. (A., 1900.)

823. DIFFERENCE OF QUANTITY, NOT OF QUALITY—*Similarity of Feeble and Violent Volcanic Eruptions.*—We are thus led to the conclusion that the grand and terrible appearances displayed at Vesuvius and other volcanoes in a state of violent eruption do not differ in any essential respect from the phenomena which we have witnessed accompanying the miniature outbursts of Stromboli. And we are convinced, by the same considerations, that the forces which give rise to the feeble displays in the latter case would produce, if acting with greater intensity and violence, all the magnificent spectacles presented in the former. In Vesuvius and Stromboli alike, the active

cause of all the phenomena exhibited is found to be the escape of steam from the midst of masses of incandescent liquefied rock. The violence, and therefore the grandeur and destructive effects, of an eruption depend upon the abundance and tension of this escaping steam.—JUDD *Volcanoes*, ch. 2, p. 31. (A., 1899.)

824. DIFFERENCES, ABSOLUTE AND RELATIVE—*Moonlight vs. Sunlight—Darkening Shadow Has the Effect of Increasing Light.*—If we compare the shadow thrown by an object in moonlight with the shadow cast by the same object in sunlight, it will be at once seen that the former appears much darker than the latter. In a landscape seen by moonlight, this stronger contrast of light and shade makes the illumination far brighter, altho it is absolutely much less intense. And from this fact we can distinguish at the first glance whether a picture represents a moonlight or a daylight scene. It is not in the power of the artist to mark this difference by an absolute difference of light-intensity. Both his paintings are equally bright; but he makes the difference between light and shadow greater in the first picture than in the second, and by this single device enables us to distinguish in a moment the night scene from the day scene.—WUNDT *Psychology*, lect. 4, p. 58. (Son. & Co., 1896.)

825. DIFFERENCES AMONG ANIMALS IN THE PHILIPPINES—Supposing that a long chain of islands had connected two lands lying far apart and differing widely in their fauna, it might be expected, and with great probability, that the fauna of this group could have retained no special homogeneous character. For the vicinity of the two terminal countries, and the currents probably existing, might easily have caused on the islands a mixture of the two dissimilar faunas. This is, in fact, sometimes the case. The Philippines lie very nearly north and south; the northern islands are connected with China by the Bashees and Formosa, while the southernmost island, Mindanao, is connected by Celebes and some smaller islands with the Moluccas, and the southwestern island, Palawan, hangs on to Borneo by Balabac. . . . A greater contrast can hardly be conceived of than that, for instance, between the fauna of Hongkong, Amoy, or even Siam, on one side, and Borneo, Java, and Sumatra, on the other. And this difference is repeated in a very striking manner in the Philippines, where the northern district displays an unmistakable harmony with the true Chinese fauna, while the southern islands show a marked resemblance partly to Borneo, partly to Celebes and Gilolo, and partly to the western islands of the Australian region.—SEMPER *Animal Life*, ch. 9, p. 283. (A., 1881.)

826. DIFFERENCES BETWEEN MAN AND APE—*An Unbridged Chasm—No Intermediate Link.*—Thus, whatever system of organs be studied, the comparison of their modifications in the ape series leads to one and the same result—that the structural differences which separate man from the gorilla and the chimpanzee are not so great as those which separate the gorilla from the lower apes.

But in enunciating this important truth, I must guard myself against a form of misunderstanding which is very prevalent. I find, in fact, that those who endeavor to teach what Nature so clearly shows us in this matter are liable to have their opinions misrepresented and their phraseology garbled until they seem to say that the structural differences between man and even the highest apes are small and insignificant. Let me take this opportunity, then, of distinctly asserting, on the contrary, that they are great and significant; that every bone of a gorilla bears marks by which it might be distinguished from the corresponding bone of a man; and that, in the present creation, at any rate, no intermediate link bridges over the gap between homo and troglodytes.

It would be no less wrong than absurd to deny the existence of this chasm; but it is at least equally wrong and absurd to exaggerate its magnitude, and, resting on the admitted fact of its existence, to refuse to inquire whether it is wide or narrow.—HUXLEY *Man's Place in Nature*, p. 232. (Hum.)

827. DIFFERENCES OF INSTRUMENTS FOR STUDY OF THE HEAVENS—*The Transit Instrument and the Equatorial—Each Has Its Own Special Value—Analogy of Spiritual Gifts (1 Cor. xiii, 4-6; Rom. xii, 6-9).*—There are two chief modes of using the telescope, to which all others may be considered subordinate. Either it may be invariably directed towards the south, with no motion save in the plane of the meridian, so as to intercept the heavenly bodies at the moment of transit across that plane; or it may be arranged so as to follow the daily revolution of the sky, thus keeping the object viewed permanently in sight, instead of simply noting the instant of its flitting across the telescopic field. The first plan is that of the "transit instrument," the second that of the "equatorial." . . .

The uses of each are entirely different. With the transit, the really fundamental task of astronomy—the determination of the movements of the heavenly bodies—is mainly accomplished; while the investigation of their nature and peculiarities is best conducted with the equatorial. One is the instrument of mathematical the other of descriptive astronomy. One furnishes the materials with which theories are constructed, and the tests by which they are corrected; the other registers new facts, takes note of new appearances, sounds the depths and pries into every nook of the heavens.—CLERKE *History of Astronomy*, pt. i, ch. 6, p. 149. (Bl., 1893.)

828. DIFFICULTIES IMPOSED UPON RELIGION—*Supernatural Power Not Denied the Use of Means.*—By "supernatural" power, do we not mean power independent of the use of means, as distinguished from power depending on knowledge—even infinite knowledge—of the means proper to be employed? This is the sense—probably the only sense—in which the supernatural is, to many minds, so difficult of belief. No man can have any difficulty in believing that there are natural laws of which he is ignorant; nor in conceiving that there may be beings who do know them, and can use them, even as he himself now uses the few laws with which he is acquainted. The real difficulty lies in the idea of will exercised without the use of means—not in the idea of will exercised through means which are beyond our knowledge, or beyond our reach. Now, have we any right to say that belief in this is essential to all religion? If we have not, then it is only putting, as so many other hasty sayings do put, additional difficulties in the way of religion.—ARGYLL *Reign of Law,* ch. 1, p. 9. (Burt.)

829. DIFFICULTIES WITH THE ETHER—*Seemingly Incompatible Qualities Involved.*—Indeed, I cannot agree with those who regard the wave theory of light as an established principle of science. That it is a theory of the very highest value I freely admit, and that it has been able to predict the phases of unknown phenomena, which experiment has subsequently brought to light, is a well-known fact. All this is true: but then, on the other side, the theory requires a combination of qualities in the ether of space, which I find it difficult to believe are actually realized. For instance, the rapidity with which wave-motion is transmitted depends, other things being equal, on the elasticity of the medium. Assuming that two media have the same density, their elasticities are proportional to the squares of the velocities with which a wave travels. The velocity of the sound-wave in air is about 1,100 feet a second or one-fifth of a mile, that of the light-wave about 192,000 miles a second, or about one million times greater; and, if we take into account certain causes, which, tho they tend to increase the velocity of sound, can have no effect on the luminiferous ether, the difference would be even greater than this. . . . It is a medium so thin that the earth, moving in its orbit 1,100 miles a minute, suffers no perceptible retardation, and yet endowed with an elasticity in proportion to its density a million million times greater than air.—COOKE *New Chemistry,* lect. 1, p. 14. (A., 1899.)

830. DIFFICULTY A SPUR TO ACTION—*Men of Northern Lands Lead the World.*—Notwithstanding the obstacles opposed in northern latitudes to the discovery of the laws of Nature, owing to the excessive complication of phenomena and the perpetual local variations that, in these climates, affect the movements of the atmosphere and the distribution of organic forms, it is to the inhabitants of a small section of the temperate zone that the rest of mankind owe the earliest revelation of an intimate and rational acquaintance with the forces governing the physical world. Moreover, it is from the same zone (which is apparently more favorable to the progress of reason, the softening of manners, and the security of public liberty) that the germs of civilization have been carried to the regions of the tropics, as much by the migratory movement of races as by the establishment of colonies.—HUMBOLDT *Cosmos,* vol. i, int., p. 36. (H., 1897.)

831. DIFFICULTY OF ATTAINING TO TRUE FAMILY LIFE—*Easy Destruction of the Ideal—Without It Nations Perish—The Best Family Life Has Best Promise of Survival.*—With the Christian era the machinery was complete; the circle finally closed in, and became a secluded shrine where the culture of everything holy and beautiful was carried on. The path by which this ideal consummation was reached was not, as we have seen, a straight path; nor has the integrity of the institution been always preserved through the later centuries. The difficulty of realizing the ideal may be judged of by the fewness of the nations now living who have reached it, and by the multitude of peoples and tribes who have vanished from the earth without attaining it. From the failure to fulfil some one or other of the required conditions, people after people and nation after nation have come together only to disperse and leave no legacy behind except the lesson—as yet in few cases understood—of why they failed.

Yet whether the road be straight or devious is of little moment. The one significant thing is that it rises. We have reached a stage in evolution at which physiological gains are guarded and accentuated, if not in an ethical interest, at least by ethical factors becoming utilized by natural selection. Henceforth affection becomes a power in the world; and whatever physiological adjustments continue to go on beneath the surface, the most attached families will have a better chance of surviving and of transmitting their moral characteristics to succeeding generations. The completion of the arch of family life forms one of the great, if not the greatest, of the landmarks of history.—DRUMMOND *Ascent of Man,* ch. 9, p. 315. (J. P., 1900.)

832. DIFFICULTY OF EXPERIMENTAL TESTS ON DEEP-SEA ANIMALS—We cannot judge at all of the amount of light given out by an animal in deep water by its appearance when thrown out of a dredge upon the deck. Whether the phosphorescent light given out by an alcyonarian or a crustacean is more or less at a tem-

perature of 40° F. and a pressure of one ton per square inch than it is at 60° F. and the ordinary barometric pressure of the sea-level is a question that has not yet been brought to an experimental test.

Whatever the answer to this question may be, the fact remains that a greater percentage of animals from the deep sea exhibit some sort of phosphorescent light when brought on deck than animals that live in shallow water.—HICKSON *Fauna of the Deep Sea,* ch. 4, p. 76. (A., 1894.)

833. DIFFICULTY OF OBTAINING KNOWLEDGE OF MANLIKE APES—*Stories Largely Mythical.*—Sound knowledge respecting the habits and mode of life of the manlike apes has been even more difficult of attainment than correct information regarding their structure.

Once in a generation, a Wallace may be found physically, mentally, and morally qualified to wander unscathed through the tropical wilds of America and of Asia, to form magnificent collections as he wanders, and withal to think out sagaciously the conclusions suggested by his collections; but, to the ordinary explorer or collector, the dense forests of equatorial Asia and Africa, which constitute the favorite habitation of the orang, the chimpanzee, and the gorilla, present difficulties of no ordinary magnitude; and the man who risks his life by even a short visit to the malarious shores of those regions may well be excused if he shrinks from facing the dangers of the interior; if he contents himself with stimulating the industry of the better-seasoned natives, and collecting and collating the more or less mythical reports and traditions with which they are too ready to supply him.

In such a manner most of the earlier accounts of the habits of the manlike apes originated; and even now a good deal of what passes current must be admitted to have no very safe foundation. The best information we possess is that based almost wholly on direct European testimony respecting the gibbons; the next best evidence relates to the orangs; while our knowledge of the habits of the chimpanzee and the gorilla stands much in need of support and enlargement by additional testimony from instructed European eye-witnesses.—HUXLEY *Man's Place in Nature,* p. 203. (Hum.)

834. DIFFICULTY OF SOCIOLOGICAL STUDY—*Positivism Would Assign It to a Caste—Possibilities of Persecution in Name of Science.*—In M. Comte's opinion, the peculiarly complicated nature of sociological studies, and the great amount of previous knowledge and intellectual discipline requisite for them, together with the serious consequences that may be produced by even temporary errors on such subjects, render it necessary, in the case of ethics and politics, still more than of mathematics and physics, that whatever legal liberty may exist of questioning and discussing, the opinions of mankind should really be formed for them by an exceedingly small number of minds of the highest class, trained to the task by the most thorough and laborious mental preparation; and that the questioning of their conclusions by any one not of an equivalent grade of intellect and instruction should be accounted equally presumptuous, and more blamable, than the attempts occasionally made by sciolists to refute the Newtonian astronomy. All this is, in a sense, true; but we confess our sympathy with those who feel towards it like the man in the story, who, being asked whether he admitted that six and five make eleven, refused to give an answer until he knew what use was to be made of it.—MILL *Positive Philosophy of Auguste Comte,* p. 70. (H. H. & Co., 1887.)

835. DIFFICULTY OF WIDE-SPREAD REFORMS—*Early Fixedness of Mental States—New Conceptions Rarely Acquired in Later Life.*—Most men begin to be old fogies at the age of twenty-five. It is true that a grown-up adult keeps gaining well into middle age a great knowledge of details, and a great acquaintance with individual cases connected with his profession or business life. In this sense, his conceptions increase during a very long period; for his knowledge grows more extensive and minute. But the larger categories of conception, the sorts of thing, and wider classes of relation between things, of which we take cognizance, are all got into the mind at a comparatively youthful date. Few men ever do acquaint themselves with the principles of a new science after even twenty-five. If you do not study political economy in college, it is a thousand to one that its main conceptions will remain unknown to you through life. Similarly with biology, similarly with electricity. What percentage of persons now fifty years old have any definite conception whatever of a dynamo, or how the trolley-cars are made to run? Surely, a small fraction of one per cent. But the boys in colleges are all acquiring these conceptions.—JAMES *Talks to Teachers,* ch. 14, p. 166. (H. H. & Co., 1900.)

836. DIGESTION OF ANIMAL MATTER BY PLANTS—*Reversal of the Common Order of Nature—Man Cannot Set Boundaries of Possibility.*—As we have seen that nitrogenous fluids act very differently on the leaves of *Drosera* [the sun-dew] from non-nitrogenous fluids, and as the leaves remain clasped for a much longer time over various organic bodies than over inorganic bodies, such as bits of glass, cinder, wood, etc., it becomes an interesting inquiry whether they can only absorb matter already in solution, or render it soluble—that is, have the power of digestion. We shall immediately see that they certainly have this power, and that they act on albuminous compounds in exactly the same manner as does the gastric juice of mammals; the di-

gested matter being afterwards absorbed. This fact, which will be clearly proved, is a wonderful one in the physiology of plants.—DARWIN *Insectivorous Plants*, ch. 6, p. 71. (A., 1900.)

837. DIRECTION, SENSE OF, IN BEES AND WASPS—*Difficulty of Learning by Experience.*—The following are Sir John Lubbock's [Lord Avebury's] observations upon this subject in the case of bees and wasps:

"Every one has heard of a 'bee-line.' It would be no less correct to speak of a wasp-line. On August 6 I marked a wasp, the nest of which was round the corner of the house, so that her direct way home was not out at the window by which she had entered, but in the opposite direction, across the room to a window which was closed. I watched her for some hours, during which time she constantly went to the wrong window, and lost much time in buzzing about at it. For ten consecutive days this wasp paid numerous visits, coming in at the open window, and always trying, tho always unsuccessfully, to return to her nest in the 'wasp-line' of the closed window—buzzing about that window for hours at a time, tho eventually on finding it closed she returned and went round through the open window by which she always entered."

This observation shows how strong must be the instinct in a wasp to take the shortest way home, and how much the insect depends upon its sense of direction in so doing. It also shows how long a time it requires to learn by individual experience the properties of a previously unknown substance, such as glass.—ROMANES *Animal Intelligence*, ch. 4, p. 144. (A., 1899.)

838. DIRECTNESS OF RAYS OF LIGHT—*Ancients Knew the Rectilinear Propagation of Light—Hence the Terms "Ray" and "Beam."*—The ancients were aware of the rectilinear propagation of light. They knew that an opaque body, placed between the eye and a point of light, intercepted the light of the point. Possibly the terms "ray" and "beam" may have been suggested by those straight spokes of light which, in certain states of the atmosphere, dart from the sun at his rising and his setting. The rectilinear propagation of light may be illustrated by permitting the solar light to enter, by a small aperture in a window-shutter, a dark room in which a little smoke has been diffused. In pure air you cannot see the beam, but in smoke you can, because the light, which passes unseen through the air, is scattered and revealed by the smoke particles, among which the beam pursues a straight course.—TYNDALL *Lectures on Light*, lect. 1, p. 9 (A., 1898.)

839. DISASTER LEADS TO DISCOVERY—*Explosiveness of Niter Demonstrated.*—The first published contribution to chemistry [under the auspices of the Smithsonian Institution] was the "Memoir on the Explosiveness of Niter," by Robert Hare. . . . Its history is interesting. A fire occurred in New York City on July 19, 1845, during which two hundred and thirty houses were destroyed, containing merchandise valued at over two millions of dollars. A peculiar feature of this catastrophe was a series of detonations successively increasing in loudness, and followed by a final explosion which tore in pieces the building where it occurred, threw down several houses in the vicinity, and forced in the fronts of houses on the opposite side of the street. These effects were attributed to gunpowder, but the owner of the building declared that he had none of that explosive, altho a large quantity of niter was stored in the house. Dr. Hare showed by numerous experiments that explosions of a violent character could be produced by forcibly bringing in contact at a high temperature niter and substances of an inflammable character.—MARCUS BENJAMIN *Chemistry in the Smithsonian Institution, History of the First Half Century*, p. 612.

840. DISASTER, POSSIBLE, MAN PROVIDES AGAINST—*Houses Built to Withstand Earthquakes.*—In South America, altho many buildings are built with brick and stone, the ordinary houses, and even the larger edifices, are specially built to withstand earthquakes. In Mr. James Douglas's account of a "Journey Along the West Coast of South America," we read the following: "The characteristic building material of Guayaquil is bamboo, which grows to many inches in thickness, and which, when cut partially through longitudinally at distances of an inch or so, and once quite through, can be opened out into fine elastic boards of serviceable width. Houses, and even churches, of a certain primitive beauty are built of such reeds, so bound together with cords that few nails enter into the construction, and which, therefore, yield so readily to the contortions of the earth during an earthquake as to be comparatively safe."—MILNE *Earthquakes*, ch. 7, p. 126. (A., 1899.)

841. DISCOVERER OF BACTERIA—*Plain Business Man Makes His Own Lenses—Advances Microscopy.*—The first scientist who demonstrated the existence of micro-organisms was Anton van Leeuwenhoek. He was born at Delft, in Holland, in 1632, and enthusiastically pursued microscopy with primitive instruments. He corroborated Harvey's discovery of the circulation of the blood in the web of a frog's foot; he defined the red blood-corpuscles of vertebrates, the fibers of the lens of the human eye, the scales of the skin, and the structure of hair. He was neither educated nor trained in science, but in the leisure time of his occupation as a linen-draper he learned the art of grinding lenses, in which he became so proficient that he was able to construct a microscope of greater power than

had been previously manufactured. The compound microscope dates from 1590, and when Leeuwenhoek was about forty years old Holland had already given to the world both microscope and telescope.—NEWMAN *Bacteria*, ch. 1, p. 1. (G. P. P., 1899.)

842. DISCOVERY A GROWTH—*Many Contribute Items—One Mind Focuses All.*—It must not be supposed that to Pasteur is due the whole credit of the knowledge acquired respecting the cause of fermentation. He did not first discover these living organisms; he did not first study them and describe them; he was not even the first to suggest that they were the cause of the processes of fermentation or disease. But, nevertheless, it was Pasteur who "first placed the subject upon a firm foundation by proving with rigid experiment some of the suggestions made by others." Thus it has ever been in the times of new learning and discovery: many contributors have added their quota to the mass of knowledge, even tho one man appearing at the right moment has drawn the conclusions and proved the theory to be fact.—NEWMAN *Bacteria*, ch. 4, p. 113. (G. P. P., 1899.)

843. ——— ——— *Partial Views and Isolated Facts Combined in Grand Total.*—Whatever the uncertainty of the field, it is due to these pioneer minds to treat their labor with respect. What they see in the unexplored land in which they travel belongs to the world. By just such methods, and by just such men, the map of the world of thought is filled in—here from the tracing up of some great river, there from a bearing taken roughly in a darkened sky, yonder from a sudden glint of the sun on a far-off mountain peak, or by a swift induction of an adventurous mind from a momentary glimpse of a natural law. So knowledge grows; and in a century which has added to the sum of human learning more than all the centuries that are past it is not to be conceived that some further revelation should not await us on the highest themes of all.—DRUMMOND *Ascent of Man*, int.. p. 2. (J. P., 1900.)

844. ——— ——— *The Sciences Help One Another.*—Nothing which succeeds is entirely new. The new-born is unformed and incapable. The greatest things are born from a state of germ, so to say, and increase unperceived. Ideas fertilize each other. The sciences help each other; progress marches. Men often feel a truth, sympathize with an opinion, touch a discovery, without knowing it. The day arrives when a synthetic mind feels in some way an idea, almost ripe, becoming incarnate in his brain: he becomes enamored of it, he fondles it, he contemplates it. It grows as he regards it. He sees, grouping round it, a multitude of elements which help to support it. To him the idea becomes a doctrine. Then, like the apostles of Good Tidings, he becomes an evangelist, announces the truth, proves it by his works, and all recognize in him the author of the new contemplation of Nature, altho all know perfectly well that he has not invented the idea, and that many others before him have foreseen its grandeur.—FLAMMARION *Popular Astronomy*, bk. iv, ch. 1, p. 342. (A.)

845. DISCOVERY BEFORE HISTORY—*Origin of Fire.*—The life of the human race may be divided into two great periods, the prehistoric and historic. But human beings had done great things before they learned to write about their doings. Among other things, they had discovered the use of fire, both as a means of warming their bodies and cooking their food. Nobody can tell how or when fire was first introduced. Lucretius has a story which ascribes its origin to the rubbing together of dry tree-branches; but this is not a likely source of ignition. Forests are sometimes set ablaze by lightning, and this is a possible origin of our domestic fires. Again, savages have everywhere employed stone implements, shaping pieces of flint with sharp edges for knives, and with sharp points for arrow-heads and spears. Sparks were certainly thus produced, and such sparks may have been the ancestors of our fires.—TYNDALL *Heat a Mode of Motion*, lect. 1, p. 11. (A., 1900.)

846. DISCOVERY BY PLAIN PEOPLE—*Accident and Wit Combined.*—In the fall of 1745, the German artisans, and especially those of Leipsic, probably recognized that the electric machine had come into good market demand. So simple was the apparatus, and so astonishing its effects, that people who made no pretense to being scientific bought it out of curiosity, and amused themselves by repeating at home the experiments which the philosophers publicly exhibited in the lecture-rooms and laboratories. When a device is thus taken to the popular bosom, so to speak, the prediction may safely be hazarded that before long some one in an unexpected quarter will discover or invent something concerning it which the philosophers have never thought of or completely missed. And the more complex the intellectual gymnastics of a certain class of these erudite persons around it, the more certain it seems to be that the discoverer will be found to have solved the problem either by his simple wits or by accident and his wits combined.—PARK BENJAMIN *Intellectual Rise in Electricity*, ch. 15, p. 511. (J. W., 1898.)

847. DISCOVERY BY SPECTRUM ANALYSIS—*Rubidium and Cæsium Found—Thallium Added.*—When Bunsen and Kirchhoff, the celebrated founders of spectrum analysis, after having established by an exhaustive examination the spectra of all known substances, discovered a spectrum containing bands different from any known bands, they immediately inferred the existence of a new metal. They were operating

at the time upon a residue, obtained by evaporating one of the mineral waters of Germany. In that water they knew the unknown metal was concealed, but vast quantities of it had to be evaporated before a residue could be obtained sufficiently large to enable ordinary chemistry to grapple with the metal. They, however, hunted it down, and it now stands among chemical substances as the metal rubidium. They subsequently discovered a second metal which they called cæsium. Thus, having first placed spectrum analysis on a sure foundation, they demonstrated its capacity as an agent of discovery. Soon afterwards Mr. Crookes, pursuing the same method, discovered the bright green band of thallium, and obtained the salts of the metal which yielded it. The metal itself was first isolated in ingots by M. Lamy, a French chemist.—TYNDALL *Lectures on Light*, lect. 6, p. 195. (A., 1898.)

848. DISCOVERY CONFIRMS CONJECTURE—*The Antarctic Continent.*—The cold of the antarctic regions was conjectured by Cook to be due to the existence of a large tract of land between the seventieth degree of south latitude and the pole. The justness of these and other speculations of that great navigator have since been singularly confirmed by the investigation made by Sir James Ross in 1841. He found Victoria Land, extending from 71° to 79° S. latitude, skirted by a great barrier of ice, the height of the land ranging from 4,000 to 14,000 feet, the whole entirely covered with snow, except a narrow ring of black earth surrounding the huge crater of the active volcano of Mount Erebus, rising 12,400 feet above the level of the sea. The position of a mountainous territory of such altitude, so near the pole, and so obvious a source of intense cold, fully explains why Graham's and Enderby's Land, discovered by Captain Biscoe in 1831-2 (between lat. 64° and 68° S.), presented a most wintry aspect, covered even in summer with ice and snow, and nearly destitute of animal life. In corresponding latitudes of the northern hemisphere we not only meet with herds of wild herbivorous animals, but with land which man himself inhabits, and where he has even built ports and inland villages.—LYELL *Principles of Geology*, bk. i, ch. 7, p. 99. (A., 1854.)

849. DISCOVERY, LONG DELAY TO REALIZE—*Humanity Waiting.*—It is interesting, and indeed pathetic, to observe how long a discovery of priceless value to humanity may be hidden away, or rather lie openly revealed, before the final and apparently obvious step is taken towards its practical application. In 1837, Schwann clearly established the connection between putrefaction and microscopic life; but thirty years had to elapse before Lister extended to wounds the researches of Schwann on dead flesh and animal infusions.—TYNDALL *Floating Matter of the Air*, int., p. 9. (A., 1895.)

850. DISCOVERY MISSED—*Stopping with an Instance—Failure of Generalization.*—Again, at Paris, in 1849, with a view to testing the asserted coincidence between the solar D-line and the bright yellow beam in the spectrum of the electric arc (really due to the unsuspected presence of sodium), Léon Foucault threw a ray of sunshine across the arc and observed its spectrum. He was surprised to see that the D-line was rendered more intensely dark by the combination of lights. To assure himself still further, he substituted a reflected image of one of the white-hot carbon-points for the sunbeam, with an identical result. The same ray was missing. It needed but another step to have generalized this result, and thus laid hold of a natural truth of the highest importance; but that step was not taken. Foucault, keen and brilliant tho he was, rested satisfied with the information that the voltaic arc had the power of stopping the kind of light emitted by it; he asked no further question, and was consequently the bearer of no further intelligence on the subject.—CLERKE *History of Astronomy*, pt. ii, ch. 1, p. 170. (Bl., 1893.)

851. DISCOVERY OF AMERICA NOT AN ISOLATED EVENT—*Way Prepared by Science.*—The discovery of the tropical regions of America by Christopher Columbus . . . cannot be regarded in the history of the contemplation of the universe as one isolated event. . . . That which imparted to the age of Columbus its peculiar character of uninterrupted and successful efforts toward the attainment of new discoveries and extended geographical knowledge was prepared slowly and in various ways. The means which contributed most strongly to favor these efforts were a small number of enterprising men, who early excited a simultaneous and general freedom of thought, and an independence of investigation into the separate phenomena of Nature; the influence exercised on the deepest sources of mental vigor by the renewed acquaintance formed in Italy with the works of ancient Greek literature; the discovery of an art which lent to thought at once wings of speed and powers of perpetuity; and the more extended knowledge of eastern Asia acquired by traveling merchants, and by monks who had been sent on embassies to the Mogul rulers, and which was diffused by them among those nations of the southwest of Europe who maintained extensive commercial relations with other countries, and who were therefore most anxious to discover a nearer route to the Spice Islands. To these means . . . we must add the advance in the art of navigation, the gradual perfection of nautical instruments, both magnetic and astronomical, and, finally, the application of certain methods for the determination of the ship's place.—HUMBOLDT *Cosmos*, vol. ii, pt. ii, p. 240. (H., 1897.)

852. DISCOVERY OF AN ANCIENT BEACH—*Rock Marked by Waves of Vanished Sea.*—The gunpowder had loosened a large mass in one of the inferior strata, and our first employment, on resuming our labors, was to raise it from its bed. I assisted the other workmen in placing it on edge, and was much struck by the appearance of the platform on which it had rested. The entire surface was ridged and furrowed like a bank of sand that had been left by the tide an hour before. I could trace every bend and curvature, every cross-hollow and counter-ridge of the corresponding phenomena; for the resemblance was no half resemblance—it was the thing itself; and I had observed it a hundred and a hundred times, when sailing my little schooner in the shallows left by the ebb. But what had become of the waves that had thus fretted the solid rock, or of what element had they been composed? I felt as completely at fault as Robinson Crusoe did on his discovering the print of the man's foot on the sand.—MILLER *The Old Red Sandstone*, ch. 1, p. 7. (G. & L., 1851.)

853. DISCOVERY OF GRAVITATION—*Newton—Story of the Apple—Earth's Attraction Already Well Understood—Newton Saw the Same Law Pervading All Space.*—But it was not till Newton came that the true meaning of these laws [of Kepler] was ascertained, and very wonderful is the history of the process by which he solved the noble problem which Nature had presented to mankind for investigation. Every one has heard the story of the apple, whose fall is said to have suggested to Newton the great discovery for which his name will be deservedly celebrated for all time. The story may be true in a sense, tho not in the sense usually given to it. Newton certainly did not ask why the apple fell, since it was well understood in his day, and had been known for many centuries, that bodies fall to the earth by virtue of her attractive influence. But it is quite possible that Newton, who had long been engaged in profound meditation on the laws of planetary motion, should have suddenly seen revealed to him the possibility that a far wider law of attraction exists. His mind was full of the thoughts suggested by the mysterious energies which appear to sway the motions of the planets; and here, suddenly, his attention was called to the mysterious energy by which the earth draws bodies to her surface. What if one and the same form of force is exerted in all such cases? What if the sun draws the planets towards him, as the earth draws unsupported bodies towards her? What if the law exemplified in the fall of the apple is a universal law?—PROCTOR *Expanse of Heaven*, p. 110. (L. G. & Co.)

854. DISCOVERY OF MAMMOTH—*Remains Preserved in Icy Tomb.*—In 1799 a Tungusian hunter discovered the body of a mammoth embedded in a cliff of frozen soil, where it remained for several years. In 1806 it was visited by Mr. Adams, who found it partly devoured by wolves and other wild animals, and partly removed by the Yakuts, who used it as food for their dogs. Fortunately, however, a considerable portion of the animal still remained. The skin was dark gray, covered with reddish wool, mixed with long black bristles, somewhat thicker than horsehair. Another frozen mammoth was discovered in 1846, besides several other well-preserved portions, and it was probably from earlier finds of a similar nature that the Siberian tribes began to regard the mammoth as a gigantic burrowing animal. It is hardly necessary to observe that the state of preservation in which mammoths have been found is no evidence of recent existence, for when once enveloped in frozen soil they might remain unchanged for an indefinite period.—AVEBURY *Prehistoric Times*, ch. 9, p. 273. (A., 1900.)

855. DISCOVERY OF MEN THE CHIEF NEED—*Wealth Can Liberate Genius from Petty Toil and Care.*—Your most difficult problem [in the United States] will be not to build institutions, but to discover men. You may erect laboratories and endow them; you may furnish them with all the appliances needed for inquiry; in so doing you are but creating opportunity for the exercise of powers which come from sources entirely beyond your reach. You cannot create genius by bidding for it. In Biblical language, it is the gift of God; and the most you could do, were your wealth, and your willingness to apply it, a millionfold what they are, would be to make sure that this glorious plant shall have the freedom, light, and warmth necessary for its development. We see from time to time a noble tree dragged down by parasitic runners. These the gardener can remove, tho the vital force of the tree itself may lie beyond him: and so, in many a case, you men of wealth can liberate genius from the hampering toils which the struggle for existence often casts around it.—TYNDALL *Lectures on Light*, p. 227. (A., 1898.)

856. DISCOVERY OF THE GULF STREAM—*Franklin's Wide Inference from Partial Observation—Genius Coordinates Facts.*—It was Franklin who first systematically observed these facts, tho they had been noticed long before by navigators. He recorded the temperature of the water as he left the American continent for Europe, and found that it continued cold for a certain distance, then rose suddenly, and after a given time sank again to a lower temperature, tho not so low as before. With the comprehensive grasp of mind characteristic of all his scientific results, he went at once beyond his facts. He inferred that the warm current, keeping its way so steadily through the broad Atlantic, and carrying tropical productions to the northern shores of Europe, must take its rise in tropical regions, must

be heated by a tropical sun. This was his inference: to work it out, to ascertain the origin and course of the Gulf Stream, has been, in a great degree, the task of the United States Coast Survey, under the direction of his descendant, Dr. Bache.—AGASSIZ *Journey in Brazil*, ch. 1 p. 6. (H. M. & Co., 1896.)

857. DISCOVERY OF THE TRANSPARENCY OF AIR—*Smokelike Clouds of Darkness.*—In a cylindrical beam, which strongly illuminated the dust of the laboratory, I placed an ignited spirit-lamp. Mingling with the flame, and round its rim, were seen curious wreaths of darkness resembling an intensely black smoke. On placing the flame at some distance below the beam, the same dark masses stormed upwards. . . . What, then, was the blackness? It was simply that of stellar space; that is to say, blackness resulting from the absence from the track of the beam of all matter competent to scatter its light. When the flame was placed below the beam the floating matter was destroyed *in situ;* and the air, freed from this matter, rose into the beam, jostled aside the illuminated particles, and substituted for their light the darkness due to its own perfect transparency. Nothing could more forcibly illustrate the invisibility of the agent which renders all things visible. The beam crossed, unseen, the black chasm formed by the transparent air, while, at both sides of the gap, the thick-strewn particles shone out like a luminous solid under the powerful illumination.—TYNDALL *Floating Matter of the Air*, p. 3. (A., 1895.)

858. DISCOVERY, PHYSICAL—*Does Not Affect Spiritual Truth—Enduring Impressiveness of Scripture.*—No amount of knowledge of the kind which alone physical science can impart can do more than widen the foundation of intelligent spiritual beliefs. We think that astronomy and geology have given to us in these latter days ideas wholly new in respect to space and time. Yet, after all, can we express these ideas, or can we indicate the questions they suggest, in any language which approaches in power to the majestic utterances of David and of Job? We know more than they knew of the magnitude of the heavenly bodies; but what more can we say than they said of the wonder of them—of Orion, of Arcturus, and the Pleiades? [Job ix, 9.] We know that the earth moves, which they did not know; and we know that the rapid rotation of a globe on its own axis is a means of maintaining the steadiness of that axis in its course through space. But what effect, except that of increasing its significance, has this knowledge upon the praise which David ascribes to that ultimate agency which has made the round world so sure "that it cannot be moved"? [Ps. xciii. 1.]—ARGYLL *Reign of Law*, ch. 2, p. 68. (Burt.)

859. DISCOVERY, THE CHARM OF—*Compensation in Wonders of Science for Lack of New Lands to Explore.*—They err who believe that the conquistadores were incited by love of gold and religious fanaticism alone. Perils always exalt the poetry of life; and, moreover, the remarkable age, whose influence on the development of cosmical ideas we are now depicting, gave to all enterprises, and to the natural impressions awakened by distant travels, the charm of novelty and surprise, which is beginning to fail us in the present well-instructed age, when so many portions of the earth are opened to us. Not only one hemisphere, but almost two-thirds of the earth, were then a new and unexplored world, as unseen as that portion of the moon's surface which the law of gravitation constantly averts from the glance of the inhabitants of the earth. Our deeply inquiring age finds in the increasing abundance of ideas presented to the human mind a compensation for the surprise formerly induced by the novelty of grand, massive, and imposing natural phenomena—a compensation which will, it is true, long be denied to the many, but is vouchsafed to the few familiar with the condition of science. To them the increasing insight into the silent operation of natural forces, whether in electro magnetism or in the polarization of light, in the influence of diathermanous substances or in the physiological phenomena of vital organisms, gradually unveils a world of wonders, of which we have scarcely reached the threshold.—HUMBOLDT *Cosmos*, vol. ii, pt. ii, p. 271. (H., 1897.)

860. DISCOVERY VALUELESS WITHOUT SCIENTIFIC KNOWLEDGE—That this first discovery of America [by the Norsemen] in or before the eleventh century should not have produced the important and permanent results yielded to the physical contemplation of the universe by the rediscovery of the same continent by Columbus at the close of the fifteenth century was the necessary consequence of the uncivilized condition of the people, and the nature of the countries to which the early discoveries were limited. The Scandinavians were wholly unprepared, by previous scientific knowledge, for exploring the countries in which they settled, beyond what was absolutely necessary for the satisfaction of their immediate wants. Greenland and Iceland, which must be regarded as the actual mother countries of the new colonies, were regions in which man had to contend with all the hardships of an inhospitable climate.—HUMBOLDT *Cosmos*, vol. ii, pt. ii, p. 236. (H., 1897.)

861. DISCRIMINATION OF SCIENCE—*Surface Indications Not Decisive—The Shell-mounds of Denmark.*—The Museum of Northern Antiquities [of Copenhagen] contains an immense collection of specimens from some very interesting shell-mounds, which are known in Denmark under the

name of "Kjökkenmöddings" (derived from Kjökken, "kitchen," and mödding, corresponding to our local word midding, a "refuse heap") [in English commonly "kitchen-midden" or "-midding"], and were long supposed to be raised beaches, like those which are found at so many points along our own shores. True raised beaches, however, necessarily contain a variety of species; the individuals are of different ages, and the shells are, of course, mixed with a considerable quantity of sand and gravel. But it was observed, in the first instance, I believe, by Professor Steenstrup, that in these supposed beaches the shells belonged entirely to full-grown, or to nearly full-grown individuals; that they consisted of four species which do not live together, nor require the same conditions, and would not, therefore, be found together alone in a natural deposit; and, thirdly, that the stratum contained scarcely any gravel, but consisted almost entirely of shells.—AVEBURY *Prehistoric Times*, ch. 7, p. 214. (A., 1900.)

862. DISEASE DEALT WITH AS A FUNCTION OF A SOUL—*Auscultation and the Like All Needless.*—The vitalistic physician considered that the essential part of the vital processes did not depend upon natural forces, which, doing their work with blind necessity and according to a fixed law, determined the result. What these forces could do appeared quite subordinate, and scarcely worthy of a minute study. He thought that he had to deal with a soul-like being, to which a thinker, a philosopher, and an intelligent man must be opposed. . . . At this time auscultation and percussion of the organs of the chest were being regularly practised in the clinical wards. But I have often heard it maintained that they were a coarse mechanical means of investigation which a physician with a clear mental vision did not need; and it indeed lowered and debased the patient, who was anyhow a human being, by treating him as a machine.—HELMHOLTZ *Popular Lectures*, lect. 5, p. 218. (L. G. & Co., 1898.)

863. DISEASE ONCE MYSTERIOUS NOW EXPLAINED—*Tetanus or Lockjaw Caused by Bacteria.*—The pathology of this terrible disease [tetanus or lockjaw] has during recent years been considerably elucidated. It was the custom to look upon it as "spontaneous," and arising no one knew how; now, however, after the experiments of Sternberg and Nicolaier, the disease is known to be due to a micro-organism common in the soil of certain localities, existing there either as a bacillus or in a resting stage of spores. Fortunately tetanus is comparatively rare, and one of the peculiar biological characteristics of the bacillus is that it grows only in the absence of oxygen [whence the special danger of a punctured wound].—NEWMAN *Bacteria*, ch. 5, p. 168. (G. P. P., 1899.)

864. DISEASES, FUNCTIONAL, MAINTAINED BY HABIT—*Cure by Sudden Arrest.*—We find how many so-called functional diseases seem to keep themselves going simply because they happen to have once begun; and the forcible cutting short by medicine of a few attacks is often sufficient to enable the physiological forces to get possession of the field again, and to bring the organs back to functions of health. Epilepsies, neuralgias, convulsive affections of various sorts, insomnias, are so many cases in point. And, to take what are more obviously habits, the success with which a "weaning" treatment can often be applied to the victims of unhealthy indulgence of passion, or of mere complaining or irascible disposition, shows us how much the morbid manifestations themselves were due to the mere inertia of the nervous organs, when once launched on a false career.—JAMES *Psychology*, vol. i, ch. 4, p. 106. (H. H. & Co., 1899.)

865. DISINFECTION, PROBLEM OF—*In Many Cases to Kill Microbes without Killing Patient, or Destroying Property.*—It should at the outset be understood that we desire in practical disinfection to inhibit or kill micro-organisms without injury to or destruction of the substance harboring the germs for the time being. If this latter is of no moment, as in rags or carcasses, burning is the simplest and most thorough treatment. But with mattresses and beddings, bedclothes and garments, as well as with the human body, it is obvious that something short of burning is required.—NEWMAN *Bacteria*, ch. 9, p. 325. (G. P. P., 1899.)

866. DISINTEGRATION OF MOUNTAINS—*Falling Fragments of Matterhorn—A Sudden Avalanche of Rocks (Job xiv, 18).*—Again and again we looked to the cliffs [of the Matterhorn] above us, ignorant of the treatment that we were to receive at their hands. We had gathered up our traps, and bent to the work before us, when suddenly an explosion occurred overhead. We looked aloft and saw in mid-air a solid shot from the Matterhorn, describing its proper parabola, and finally splitting into fragments as it smote one of the rocky towers in front of us. Down the scattered fragments came like a kind of spray, slightly wide of us, but still near enough to compel a sharp lookout. Two or three such explosions occurred, but we chose the back-fin of the mountain for our track, and from this the falling stones were speedily deflected right or left. Before the set of sun we reached our place of bivouac.—TYNDALL *Hours of Exercise in the Alps*, ch. 14, p. 158. (A., 1898.)

867. DISINTEGRATION OF ROCKS—*Earth and Ocean-floor Covered with Rock-débris.*—The disintegration and decomposition of rocks is a process everywhere being

carried on—from the crests of the mountains down to the sea, and in every latitude under the sun. No exposed rock-surface escapes attack. In parched deserts as in well-watered regions, in the dreary barrens of the far north as in the sunny lands of the south, at lofty elevations as in low-lying plains, the work of rock-waste never ceases. Here it is insolation that is the most potent agent of destruction: there it is rain aided by humus and carbonic acids; or rain and frost combine their forces to shatter and pulverize the rocks. In latitudes where frost acts energetically, the most conspicuous proofs of rock-waste are the sheets and heaps of débris that are ever traveling down mountain slopes, or gathering at the base of cliff and precipice. In lower latitudes the most impressive evidence of disintegration is the great thickness attained by rotted rock in positions where it is not liable to be readily swept away by running water.—GEIKIE *Earth Sculpture*, ch. 2, p. 29. (G. P. P., 1898.)

868. ——— ——— *Heat and Cold Break Down—Wind Scatters in Dust.*—Rocks at the surface are everywhere subject to changes of temperature—warmed by day and during summer, cooled at night and during winter. Thus they alternately expand and contract, and this tends to disintegration, for the materials of which they are composed often yield unequally to strain or tension. In the rocky deserts of tropical and subtropical regions, bare of verdure and practically rainless, the effects produced by alternate heating and cooling are very marked. The rocks are cracked and shattered to a depth of several inches; the surfaces peel off, and are rapidly disintegrated and pulverized. Wind then catches up the loose material and sweeps it away, leaving fresh surfaces exposed to the destructive action of insolation. More than this, the grit, sand, and dust carried off by the wind are used as a sand-blast to attack and erode the rocks against which they strike.—GEIKIE *Earth Sculpture*, ch. 2, p. 23. (G. P. P., 1898.)

869. DISORDERS OF SOCIETY FROM TRANSGRESSION OF NATURAL LAW—*Evil Points the Way to Betterment.*—Is it vain to hope that the thoughtfulness and candor which have been the natural inheritance of a few may yet be more common among all educated men? The whole constitution and course of things would receive an earlier fulfilment did we carry about with us an habitual belief in the inexhaustible treasures which it holds—in the power of the agencies which it offers to knowledge and contrivance. For then the results of natural consequence would be accepted for that which they teach, and not simply submitted to for that which they inflict. The disorders of society would not so often be supinely regarded as the result of inevitable laws, but would be seen as the fruit always of some ignorance or of some rebellion; and so the exhilarating conviction would be ours that those disorders are within the reach of remedy through larger knowledge and a better will.—ARGYLL *Reign of Law*, ch. 7, p. 229. (Burt.)

870. DISPERSAL OF PLANTS—*Effected by Animals.*—Sometimes an express provision is found in the structure of seeds to enable them to adhere firmly by prickles, hooks, and hairs, to the coats of animals, or feathers of the winged tribe, to which they remain attached for weeks, or even months, and are borne along into every region whither birds or quadrupeds may migrate. Linnæus enumerates fifty genera of plants, and the number now known to botanists is much greater, which are armed with hooks, by which, when ripe, they adhere to the coats of animals. . . . A deer has strayed from the herd when browsing on some rich pasture, when he is suddenly alarmed by the approach of his foe. He instantly takes to flight, dashing through many a thicket, and swimming across many a river and lake. The seeds of the herbs and shrubs which have adhered to his smoking flanks are washed off again by the waters. The thorny spray is torn off, and fixes itself in its hairy coat, until brushed off again in other thickets and copses.—LYELL *Principles of Geology*, ch. 37, p. 624. (A., 1854.)

871. ——— ——— *Effected by Man.*—Besides the plants used in agriculture, the numbers which have been naturalized by accident, or which man has spread unintentionally, are considerable. One of our old authors, Josselyn, gives a catalog of such plants as had, in his time, sprung up in the colony since the English planted and kept cattle in New England. They were two-and-twenty in number. The common nettle was the first which the settlers noticed: and the plantain was called by the Indians "Englishman's foot," as if it sprung from their footsteps.—LYELL *Principles of Geology*, ch. 37, p. 625. (A., 1854.)

872. DISPERSAL OF SEEDS GRADUAL—*Nature's Thrashing-machine—Balls of Buttonwood.*—The fruit of the buttonwood, or sycamore, which grows along streams, is in the form of balls an inch and a half in diameter. These balls grow on the tops of the highest branches, and hold on into winter or longer. The stems are about two inches long, and soon after drying, through the action of the winds, they become very flexible, each resembling a cluster of tough strings. The slightest breeze moves them, and they bob around against each other and the small branches in an odd sort of way. After so much thrashing that they can hold no longer, the little nuts become loosened and begin to drop off a few at a time. Certain birds eat a few and loosen others, which escape, . . . each supplied with a ring of bristles about the base, which acts as a

parachute to permit the wind the easier to carry them for some distance before falling, or to drift them on the surface of the snow or ice.—BEAL *Seed Dispersal,* ch. 5, p. 39. (G. & Co., 1898.)

873. DISPUTATION ON NAMES RATHER THAN THINGS—*Agreement amid Controversy.*—A man that is of judgment and understanding shall sometimes hear ignorant men differ, and know well within himself that those which so differ mean one thing, and yet they themselves would never agree; and if it come so to pass in that distance of judgment which is between man and man, shall we not think that God above, that knows the heart, doth not discern that frail men, in some of their contradictions, intend the same thing; and accepteth of both?—BACON *Essays,* essay 4, *Of Revenge,* p. 15. (W. L. A.)

874. DISTANCE OF ONLY ONE STAR CERTAINLY KNOWN—Tho no discredit whatever can attach to astronomers for failing to determine exactly quantities which are in reality all but evanescent, yet no more reliance must be placed on the estimates of star-distances than shall appear to be justified by the accordance of different and independent determinations. . . . So that the startling but inevitable conclusion is deduced that there is but one star in the heavens of whose distance astronomers have any definite ideas. This star is the one known as Alpha Centauri; and hitherto all observations agree in placing it at about twenty-two millions of millions of miles from the earth.—PROCTOR *Our Place among Infinities,* p. 167. (L. G. & Co., 1897.)

875. DISTANCE OF SUN FROM EARTH—*Expressed in Speed of Cannon-ball and of Railroad Train.*—As to the distance of ninety-three million miles, a cannon-ball would travel it in about fifteen years. It may help us to remember that at the speed attained by the limited express on our railroads a train which had left the sun for the earth when the "Mayflower" sailed from Delftshaven with the Pilgrim Fathers, and which ran at that rate day and night, would in 1887 still be a journey of some years away from its terrestrial station. The fare at the customary rates, it may be remarked, would be rather over two million five hundred thousand dollars, so that it is clear that we should need both money and leisure for the journey.—LANGLEY *New Astronomy,* ch. 1, p. 5. (H. M. & Co., 1896.)

876. DISTANCE PENETRATED—*Spectroscope Measures Orbits and Speed of Stars by Light That Left Them Forty-seven Years Ago.*—[Dr. Vogel] from his study of the spectra of the variable star Algol, has been able to determine that both the visible star and its dark companion are somewhat larger than our sun, tho of less density; that their centers are 3,230,000 miles apart, and that they move in their orbits at rates of 55 and 26 miles per second respectively; and this information, it must be remembered, has been gained as to objects the light of which takes about forty-seven years to reach us!—WALLACE *The Wonderful Century,* ch. 6, p. 48. (D. M. & Co., 1899.)

877. DISTANCES, INCONCEIVABLE, OF THE STARS—*Light Millions of Years in Coming Thence—Exalted Ideas of Time and Space.*—Now, light takes more than eight minutes in reaching us from the sun, whose distance is more than 91,000,000 of miles; and it is easily calculated that the long journey from Sirius cannot be traversed in less than fifteen years. More probably it requires upwards of twenty years; and the greater number of the stars we see on a dark and clear night lie very much farther away than Sirius. Some of them certainly lie at distances which light can only traverse in hundreds of years. So soon as we turn, however, to telescopic stars, the range of time over which our vision extends is enormously increased, and it is certainly not too much to say that some of the fainter stars revealed by the great Rosse telescope lie at distances so enormous that their light has taken more than a hundred thousand years in reaching us. Then beyond these stars lie millions and millions of orbs yet farther away. There is no limit to the range of space occupied thus with the work of God's hands. All that has been taught us by astronomy suggests the lesson that every moment light reaches this earth from unseen orbs so far away that the journey over the vast abysses separating us from them has not been completed in less than millions of years.—PROCTOR *Expanse of Heaven,* p. 202. (L. G. & Co., 1897.)

878. ——— ——— *Yet Far-off Stars Obey Unchanging Law.*—But it was not merely in the region of the attraction of our sun that the law of gravitation was found to hold. With regard to the fixed stars, it was found that double stars moved about each other in elliptical paths, and that therefore the same law of gravitation must hold for them as for our planetary system. The distance of some of them could be calculated. The nearest of them, *α* in the constellation of the Centaur, is 270,000 times further from the sun than the earth. Light, which has a velocity of 186,000 miles a second, which traverses the distance from the sun to the earth in eight minutes, would take four years to travel from *α* Centauri to us. The more delicate methods of modern astronomy have made it possible to determine distances which light would take thirty-five years to traverse—as, for instance, the pole-star; but the law of gravitation is seen to hold, ruling the motion of the double stars, at distances in the heavens, which all the means we possess have hitherto utterly failed to measure.—HELMHOLTZ *Popular Lectures,* lect. 4, p. 149. (L. G. & Co., 1898.)

879. DISTINCTION BETWEEN SUCCESSION AND CAUSATION—*Day and Night vs. Rotation of the Earth.*—He [Comte] has an objection to the word cause; he will only consent to speak of laws of succession: and depriving himself of the use of a word which has a positive meaning, he misses the meaning it expresses. He sees no difference between such generalizations as Kepler's laws and such as the theory of gravitation. He fails to perceive the real distinction between the laws of succession and coexistence which thinkers of a different school call laws of phenomena, and those of what they call the action of causes: the former exemplified by the succession of day and night, the latter by the earth's rotation which causes it. The succession of day and night is as much an invariable sequence as the alternate exposure of opposite sides of the earth to the sun. Yet day and night are not the causes of one another; why? Because their sequence, tho invariable in our experience, is not unconditionally so: those facts only succeed each other, provided that the presence and absence of the sun succeed each other; and if this alternation were to cease, we might have either day or night unfollowed by one another. There are thus two kinds of uniformities of succession, the one unconditional, the other conditional on the first: laws of causation, and other successions dependent on those laws.—MILL *Positive Philosophy of Auguste Comte*, p. 54. (H. H. & Co., 1887.)

880. DISTINCTIONS LITTLE NOTED BY AVERAGE MIND—*Horse-stealing vs. Sheep-stealing.* — Professor de Morgan, thinking, it is true, rather of conceptual than of perceptive discrimination, wrote, wittily enough:

"The great bulk of the illogical part of the educated community—whether majority or minority I know not: perhaps six of one and half a dozen of the other—have not power to make a distinction, and of course cannot be made to take a distinction, and of course never attempt to shake a distinction. With them all such things are evasions, subterfuges, come-offs, loopholes, etc. They would hang a man for horse-stealing under a statute against sheep-stealing, and would laugh at you if you quibbled about the distinction between a horse and a sheep."—JAMES *Psychology*, vol. i, ch. 12, p. 509. (H. H. & Co., 1899.)

881. DISTRACTION OF ATTENTION FROM GRIEF—*Help to Forgetfulness—Volition the Latest Resource.*—We will take the case of a man who has sustained a great shock by the loss of a dearly loved wife, child, or friend, a disappointed affection, or commercial ruin. His physical condition is lowered, the power of his will is weakened, the painful impression seems branded into his innermost nature, he cannot help feeling it most acutely, he seems powerless to withdraw himself from it. He may be exhorted to "rouse himself"; every conceivable motive may be suggested to him for doing so; but all in vain. What is needed is the complete distraction of his attention from brooding over his misfortune; and the force which the weakened will cannot of itself exert must be supplied by the attractive influence of new scenes and persons, and the complete severance from painful associations. He yields himself passively to his advisers; at first "all seems barren, from Dan to Beersheba"; he looks up into the dome of St. Peter's, or down into the crater of Vesuvius, and finds "nothing in it." But gradually his bodily health improves; he begins to show some interest in what he sees and hears; and a judicious companion, like a good nurse, watches for every sign, and encourages every movement in the right direction, noticing what proves most attractive, and secretly planning to bring its attractions into play. At first the patient seems ashamed of being cheerful, and falls back into his moodiness, as if he felt it a duty to hug the memory of his lost happiness; but these relapses, after a time, become less and less frequent. He begins to find that it is really much pleasanter to forget himself, and to make himself agreeable to others, than it is to brood morosely over his troubles. With the reinvigoration of his bodily health, his volitional power gradually returns; and he comes to feel that he can resist the tendency to revert to them by determinately giving his attention to the objects around him. The resisting power required becomes less and less the more frequently it is exerted, and at length the mental health is completely restored—the brooding tendency, however, being apt to recur, either when the will is weakened by physical fatigue, or when old associations are revived with peculiar force and vividness.—CARPENTER *Mental Physiology*, bk. i, ch. 7, p. 334. (A., 1900.)

882. DISTRIBUTION, GRADUAL, OF MAMMALIA OVER THE EARTH—It is evident that the distribution of animals over the earth's surface to-day, or their distribution through past time, as evidenced by their fossil remains, both point to a gradual and natural origin and distribution of every kind of beast composing the mammalian class. We say of every kind of beast, because as regards man no reasonable opinion could be gathered from the facts set down in this series of essays.—MIVART *Types of Animal Life*, ch. 12, p. 374. (L. B. & Co., 1893.)

883. DISTRIBUTION OF PLANTS STRIKINGLY IRREGULAR—The struggle for existence in plants is, therefore, threefold in character and infinite in complexity, and the result is seen in their curiously irregular distribution over the face of the earth. Not only has each country its distinct plants, but every valley, every hillside, almost every hedgerow, has a different

set of plants from its adjacent valley, hill-side, or hedgerow—if not always different in the actual species, yet very different in comparative abundance, some which are rare in the one being common in the other.—WALLACE *Darwinism*, ch. 2, p. 12. (Hum., 1889.)

884. DISTRIBUTION OF SEEDS—*The Milkweed.*—Every one who has wandered along a country road has noticed the peculiar seed-pods of the common milkweed. . . . As the pods open there is revealed a large number of flattened brown seeds. . . . Each seed bears on its smaller end a tuft of silken hairs. When the pod first opens these hairs lie straight and flat, the ends of the hairs being caught in the folds of the membranous partition which runs through the center of the pod.

On exposure to the air the folds relax their hold upon the hairs, which thus become free at their upper ends. Then each hair curls over toward the other end of the seed, until at last nearly all the hairs on the upper seeds are thus curled over, forming a beautiful crown almost as light as air. When a strong wind blows, the seeds are picked up by means of these hairs and carried away to be dropped beside some fence or tree or bush. By the beautiful device of this feathery crown the milkweed provides for the scattering of its seeds. It seems a simple process, but as you think it over you see that it is a very admirable one.—WEED *Seed-travellers*, pt. i, p. 1. (G. & Co., 1899.)

885. DISTRIBUTION OF STARS UNEQUAL—*Rich and Poor Celestial Regions—Magellanic Clouds—Aggregations of Light and Power.*—In working, then, by the method of charting I began (for I may as well note that I have been practically alone in this work) by charting the stars that we can see, according to a plan by which the laws of distribution should be clearly recognized; for the charts I drew were so contrived that equal spaces on the celestial sphere should be represented by equal spaces in the chart. It quickly became clear that the stars are not scattered at all uniformly over the heavens. There are rich and poor regions; and these are so arranged that while the whole of the galactic region is exceedingly rich in naked-eye stars, two opposite rich regions, one in the northern and the other in the southern heavens, are separated from each other (except where the Milky Way on opposite sides passes from one to the other) by singularly barren regions. It appears a noteworthy circumstance that near the center of the great southern rich region are found those two wonderful objects called the Magellanic clouds, vast globe-shaped conglomerations (scarcely any other word seems so suitable) in which are contained not only myriads of stars of all orders of magnitude after the seventh, but also every kind of star cloudlet.—PROCTOR *Expanse of Heaven*, p. 268. (L. G. & Co., 1897.)

886. DIVING-BELL, THE FIRST—*Home of the Water-spider—Transporting and Storing Air.*—The water-spider (*Argyroneta aquatica*), as is well known, displays the curious instinct of building her nest below the surface of water, and constructing it on the principle of a diving-bell. The animal usually selects still waters for this purpose, and makes her nest in the form of an oval hollow, lined with web, and held secure by a number of threads passing in various directions and fastened to the surrounding plants. In this oval bell, which is open below, she watches for prey, and, according to Kirby, passes the winter after having closed the opening. The air needful for respiration the spider carries from the surface of the water. To do this she swims upon her back in order to entangle an air-bubble upon the hairy surface of her abdomen. With this bubble she descends, "like a globe of quicksilver," to the opening of her nest, where she liberates it and returns for more.—ROMANES *Animal Intelligence*, ch. 6, p. 211. (A., 1899.)

887. DIVISION BY DEPRESSION AMONG THE FAUNA OF THE DEEP SEA—It would be quite possible, however, to subdivide the [terrestrial] geographical areas into zones of elevation above the sea-level, not very clearly marked off from one another, it is true, but nevertheless each showing a number of characteristic features. This idea is expressed, for example, when we speak of the Alpine fauna, the Himalayan fauna, or the fauna of the great Andes.

In the study of the marine fauna and flora we must notice, it is the depth of the water, or in other words the depression of the habitats below the sea-level, that forms the most important consideration. Geographical subregions may be recognized and defined with a certain amount of accuracy, especially in the case of the fauna of the shallow waters, but by far the most important changes in the general characters of the fauna are found when we pass from one "zone" of depression to another.—HICKSON *Fauna of the Deep Sea*, ch. 3, p. 46. (A., 1894.)

888. DIVISION LESSENS CONDUCTIVITY—*Red-hot Iron Ball Held in the Hand—Cause of Warmth of Fur.*—Pure silica, in the state of hard rock-crystal, is a better conductor than bismuth or lead; but if the crystal be reduced to powder, the propagation of heat is exceedingly slow. Through transparent rock salt heat is copiously conducted, through common table salt very feebly. Asbestos is composed of certain silicates in a fibrous condition; I place some asbestos on my hand, and on it a red-hot iron ball. The ball can be thus held without inconvenience. That the division of the substance should interfere with the transmission might reasonably be inferred: for, heat being motion, anything which disturbs the continuity of the molecular chain, along which the motion is conveyed, must affect

the transmission. In the case of the asbestos, the fibers are separated from each other by spaces of air; the motion has to pass from solid to air, and from air to solid. It is easy to see that the transmission of vibratory motion through this composite texture must be very imperfect. In the case of an animal's fur this is more especially the case; for here, not only do spaces of air intervene between the hairs, but the hairs themselves, unlike the fibers of the asbestos, are very bad conductors. Lava has been known to flow over a layer of ashes underneath which was a bed of ice, the non-conductivity of the ashes saving the ice from fusion. Red-hot cannon-balls have been wheeled to the gun's mouth in wooden barrows partially filled with sand. Ice is packed in sawdust, to prevent it from melting; powdered charcoal is also an eminently bad conductor.—TYNDALL *Heat a Mode of Motion*, lect. 9, p. 258. (A., 1900.)

889. DIVISION OF BIELA'S COMET —*An Unexpected Astronomical Spectacle.*—It [Biela's comet] was seen again in 1845, on November 25, near the place assigned to it by calculation, and its course was duly followed. Everything went on to the general satisfaction, when—unexpected spectacle!—on January 13, 1846, the comet split into two! What had passed in its bosom? Why this separation? What was the cause of such a celestial cataclysm? We do not know; but the fact is that, instead of one comet, two were henceforth seen, which continued to move in space like two twin sisters—two veritable comets, each having its nucleus, its head, its coma, and its tail, slowly separating from each other; on February 10 there was already 60,000 leagues (about 149,000 miles) of space between the two. They would seem, however, to have parted with regret, and during several days a sort of bridge was seen thrown from one to the other. The cometary couple, departing from the earth, soon disappeared in the infinite night.

They returned within view of the earth in the month of September, 1852; on the 26th of this month the twins reappeared, but much farther apart, separated by an interval of 500,000 leagues (about 1,250,000 miles).—FLAMMARION *Popular Astronomy*, bk. v, ch. 2, p. 499. (A.)

890. DIVISION OF LABOR—*Among Ancient Organisms—Distinctive Organs Mark Higher Type of Structure.*—Other species of bivalves were also introduced, approaching more nearly our clams and oysters. . . . They differ from the brachiopods chiefly in the higher character of their breathing apparatus; for they have free gills, instead of the network of vessels on the lining skin which serves as the organ of respiration in the brachiopods. We shall always find that in proportion as the functions are distinct, and, as it were, individualized by having special organs appropriated to them, animals rise in the scale of structure.—AGASSIZ *Geological Sketches*, ser. i, ch. 3, p. 85. (H. M. & Co., 1896.)

891. ——— ——— *Between Associated Organisms—Lichens Communities of Algæ and Fungi—Organisms Mutually Cooperating.* — Incredible as the statement once seemed, it is a statement now accepted, that what we know as lichens, and used to consider as plants forming a certain low class, are now found to be not plants in the ordinary sense at all, but compound growths formed of minute algæ and minute fungi, carrying on their lives together: the algæ furnishing to the fungi certain constituents they need, but cannot directly obtain, and the fungi profiting by certain materials they obtain from the algæ, either while living or while individually decaying. Whence it would seem that after the microscopic vegetal type had become in a large degree differentiated into two main types, in adaptation to different conditions of life, and had acquired appropriate specialties of nature, there grew up this communistic arrangement between certain of them, enabling each to benefit by the powers which the other had acquired: evidently an exchange of services, a physiological division of labor, a mutual dependence of functions analogous to that which exists between functions in an ordinary plant or animal.—SPENCER *Biology*, pt. v, ch. 10A, p. 339. (A., 1900.)

892. ——— ——— *Marks the Progress of Nations.*—A comparative survey of the history of nations, or what is called "universal history," will readily yield to us, as the first and most general result, evidence of a continually increasing variety of human activities, both in the life of individuals and in that of families and states. This differentiation or separation, this constantly increasing divergence of human character and the form of human life, is caused by the ever advancing and more complete division of labor among individuals. While the most ancient and lowest stages of human civilization show us throughout the same rude and simple conditions, we see in every succeeding period of history, among different nations, a greater variety of customs, practises, and institutions.—HAECKEL *History of Creation*, vol. i, ch. 12, p. 319. (K. P. & Co., 1899.)

893. DIVISION OF PERSONALITY BY PHRENOLOGY—*Horse Inside of Locomotive.*—"We have [according to phrenology] a parliament of little men together, each one of whom, as happens also in a real parliament, possesses but a single idea which he ceaselessly strives to make prevail"—benevolence, firmness, hope, and the rest. "Instead of one soul, phrenology gives us forty, each alone as enigmatic as the full aggregate psychic life can be. Instead of dividing the latter into effective elements, she divides it into personal beings of peculiar character. . . . 'Herr Pastor, sure there

be a horse inside,' called out the peasants to X after their spiritual shepherd had spent hours in explaining to them the construction of the locomotive. With a horse inside truly everything becomes clear, even tho it be a queer enough sort of horse—the horse itself calls for no explanation! Phrenology takes a start to get beyond the point of view of the ghostlike soul entity, but she ends by populating the whole skull with ghosts of the same order." [Quoted from Lange, "Geschichte des Materialismus," 2d ed., vol. ii, p. 345.]—JAMES *Psychology*, vol. i, ch. 2, p. 29. (H. H. & Co., 1899.)

894. DOGMA DANGEROUS TO DISPUTE—*Air in Arteries of the Dead—Therefore of the Living—The Liver a Manufactory of Blood.*—The fact that air is generally found in the arteries of dead bodies, which indeed only penetrates in the moment in which the vessels are cut, led the ancients to the belief that air is also present in the arteries during life. The veins only remained then in which blood could circulate. It was believed to be formed in the liver, to move from there to the heart, and through the veins to the organs. Any careful observation of the operation of blood-letting must have taught that, in the veins, it comes from the periphery, and flows towards the heart. But this false theory had become so mixed up with the explanation of fever and of inflammation that it acquired the authority of a dogma, which it was dangerous to attack.—HELMHOLTZ *Popular Lectures*, lect. 5, p. 211. (L. G. & Co., 1898.)

895. DOGMAS ONCE IDENTIFIED WITH RELIGION—*Christianity Not Shaken by Their Overthrow.*—We of the present time can only wonder at the obstinacy with which the self-styled "orthodox" have clung to the idea that the world with its living inhabitants was created in six successive days of the year 4004 B. C., the Creator resting from his labors on the seventh; that our own terrestrial globe is the fixed center of the universe—sun and moon, stars and planets, revolving around it every twenty-four hours; that not more than 6,000 years have elapsed since man was first called into being; and that the Noachian deluge extended over the whole globe and destroyed all the animals then living on its surface, except the few pairs that found a refuge in the ark. As each of these positions has been successively impugned by scientific research, theologians have raised the cry that the foundations of Christianity were being undermined; and yet they have now, tacitly if not openly, agreed to abandon them all, as ancient traditions altogether destitute of historical value. That theology has gained and not lost by this abandonment, I do not suppose that any one now doubts.—CARPENTER *Nature and Man*, lect. 15, p. 410. (A., 1889.)

896. DOGMATISM OF SCIENTIST—*Experience to Prove Matter Eternal.*—Creation in the former sense, as the coming into existence of matter, does not concern us here at all. This process, if indeed it ever took place, is completely beyond human comprehension, and can therefore never become a subject of scientific inquiry. Natural science teaches that matter is eternal and imperishable, for experience has never shown us that even the smallest particle of matter has come into existence or passed away.—HAECKEL *History of Creation*, vol. i, ch. 1, p. 8. (K. P. & Co., 1899.)

897. DOGS INSEPARABLE AND UNIVERSAL COMPANIONS OF MEN—Since the discovery of flint tools in the superficial formations of many parts of the world, all geologists believe that barbarian men existed at an enormously remote period; and we know that at the present day there is hardly a tribe so barbarous as not to have domesticated at least the dog.—DARWIN *Origin of Species*, ch. 1, p. 16. (Burt.)

898. DOGS MADE OBJECTS OF WORSHIP—*Wild Dogs of European Extraction—Native Dogs of South America.*—In the pampas of Buenos Ayres the traveler meets with European dogs, which have become wild. They live gregariously in holes and excavations, in which they conceal their young. When the horde becomes too numerous, several families go forth, and form new settlements elsewhere. The European dog barks as loudly after it has become wild as does the indigenous American hairy species. Garcilaso asserts that, prior to the arrival of the Spaniards, the Peruvians had a race of dogs called *Perros gozques;* and he calls the indigenous dog *Allco.* In order to distinguish this animal from the European variety, it is called in the Qquichua language *Runa-allco*, Indian dog, or dog of the natives. The hairy *Runa-allco* appears to be a mere variety of the shepherd's dog. It is, however, smaller, has long yellow-ochery colored hair, is marked with white and brown spots, and has erect and pointed ears. It barks continually, but seldom bites the natives, however it may attack the whites. When the Inca Pachacutec, in his religious wars, conquered the Indians of Xauxa and Huanca (the present valley of Huancaya and Jauja), and compelled them by force to submit to the worship of the sun, he found that dogs were made the objects of their adoration, and that the priests used the skulls of these animals as wind-instruments. It would also appear that the flesh of this canine divinity was eaten by the believers.—HUMBOLDT *Views of Nature*, p. 85. (Bell, 1896.)

899. DOING, VALUE OF—*Contrast with Mere Saying—Determines Character (Matt. vii, 24-29).*—The most colossal improvement which recent years have seen in secondary education lies in the introduction of the manual training-schools; not because they will give us a people more handy and

practical for domestic life and better skilled in trades, but because they will give us citizens with an entirely different intellectual fiber. Laboratory work and shop work engender a habit of observation, a knowledge of the difference between accuracy and vagueness, and an insight into Nature's complexity and into the inadequacy of all abstract verbal accounts of real phenomena, which, once wrought into the mind, remain there as lifelong possessions. They confer precision; because, if you are doing a thing, you must do it definitely right or definitely wrong. They give honesty; for, when you express yourself by making things, and not by using words, it becomes impossible to dissimulate your vagueness or ignorance by ambiguity. They beget a habit of self-reliance; they keep the interest and attention always cheerfully engaged, and reduce the teacher's disciplinary functions to a minimum.—JAMES *Talks to Teachers*, ch. 5, p. 35. (H. H. & Co., 1900.)

900. DOMESTICATION OF ANIMALS—*Wonderful Triumph of Humanity.*—Nowhere has man pressed his hand so effectively upon Nature as in the domestication of animals. It is almost incredible that ravening wolves and merciless felines should become faithful dogs and purring cats; that the wild sheep and goat should descend from their inaccessible fastnesses, and yield their fleece and flesh and milk; that horses, asses, camels, elephants, should be induced to lend their backs and limbs to lighten the loads of the first common carrier. This process of impressing his own qualities on wild creatures began very early in history and has continued uninterruptedly from first to last. —MASON *The Birth of Invention. Address at Centenary of Amer. Patent System, Washington, D. C., 1891, Proceedings of the Congress*, p. 410

901. DOMESTICITY — *Woman Makes Home—A Child Its Center.*—With the physical program carried out to the last detail, the ethical drama opened. An early result, partly of her sex, and partly of her passive strain, is the founding through the instrumentality of the first savage mother of a new and a beautiful social state—domesticity. While man, restless, eager, hungry, is a wanderer on the earth, woman makes a home. And tho this home be but a platform of sticks and leaves, such as the gorilla builds on a tree, it becomes the first great schoolroom of the human race. For one day there appears in this roofless room that which is to teach the teachers of the world —a little child.—DRUMMOND *Ascent of Man*, ch. 8, p. 280. (J. P., 1900.)

902. DOMINION OF MAN OVER NATURE—*Power of Coordinating Impressions—Analysis and Comparison of Ideas the Foundation of Human Language.*—Beyond a doubt, man . . . in some way possesses, by virtue of his superior brain, a power of coordinating the impressions of his senses, which enables him to understand the world he lives in, and by understanding to use, resist, and even in a measure rule it. No human art shows the nature of this human attribute more clearly than does language. Man shares with the mammalia and birds the direct expression of the feelings by emotional tones and interjectional cries; the parrot's power of articulate utterance almost equals his own; and, by association of ideas in some measure, some of the lower animals have even learned to recognize words he utters. But, to use words in themselves unmeaning, as symbols by which to conduct and convey the complex intellectual processes in which mental conceptions are suggested, compared, combined, and even analyzed, and new ones created—this is a faculty which is scarcely to be traced in any lower animal.—DANIEL WILSON *Anthropology*, ch. 2, p. 5. (Hum., 1885.)

903. ——— ——— *Control by Obedience to Law.*—A great philosopher has observed that we can command Nature only by obeying her laws; and this principle is true even in regard to the astonishing changes which are superinduced in the qualities of certain animals and plants by domestication and garden culture. . . . We can only effect such surprising alterations by assisting the development of certain instincts, or by availing ourselves of that mysterious law of their organization by which individual peculiarities are transmissible from one generation to another.—LYELL *Principles of Geology*, bk. i. ch. 9, p. 151. (A., 1854.)

904. DOUBT AS A DISEASE—*Skepticism Carried to Absurdity—Discussion Preventing Action.*—"To one whose mind is healthy thoughts come and go unnoticed; with me they have to be faced, thought about in a peculiar fashion, and then disposed of as finished, and this often when I am utterly wearied and would be at peace; but the call is imperative. This goes on to the hindrance of all natural action. If I were told that the staircase was on fire and I had only a minute to escape, and the thought arose—'Have they sent for fire-engines? Is it probable that the man who has the key is on hand? Is the man a careful sort of person? Will the key be hanging on a peg? Am I thinking rightly? Perhaps they don't lock the depot'—my foot would be lifted to go down; I should be conscious to excitement that I was losing my chance; but I should be unable to stir until all these absurdities were entertained and disposed of. In the most critical moments of my life, when I ought to have been so engrossed as to leave no room for any secondary thoughts, I have been oppressed by the inability to be at peace. And in the most ordinary circumstances it is all the same. Let me instance the other morning I went to walk. The day was biting cold, but I was unable to proceed except by jerks. Once I

got arrested, my feet in a muddy pool. One foot was lifted to go, knowing that it was not good to be standing in water, but there I was fast, the cause of detention being the discussing with myself the reasons why I should not stand in that pool."—T. S. CLOUSTON, quoted by JAMES in *Psychology*, vol. ii, ch. 21, p. 284. (H. H. & Co., 1899.)

905. DOUBT CONSECRATED BY DESCARTES—*His Search Still for Certainty.*—The central propositions of the whole "Discourse" [of Descartes on "The Right Use of the Reason"] are these: There is a path that leads to truth so surely that any one who will follow it must needs reach the goal, whether his capacity be great or small. And there is one guiding rule by which a man may always find this path, and keep himself from straying when he has found it. This golden rule is—give unqualified assent to no propositions but those the truth of which is so clear and distinct that they cannot be doubted. The enunciation of this great first commandment of science consecrated doubt. . . . When I say that Descartes consecrated doubt, you must remember that it was that sort of doubt which Goethe has called "the active skepticism, whose whole aim is to conquer itself"; and not that other sort which is born of flippancy and ignorance, and whose aim is only to perpetuate itself, as an excuse for idleness and indifference. But it is impossible to define what is meant by scientific doubt better than in Descartes's own words. After describing the gradual progress of his negative criticism, he tells us: "For all that, I did not imitate the skeptics, who doubt only for doubting's sake, and pretend to be always undecided; on the contrary, my whole intention was to arrive at certainty, and to dig away the drift and the sand until I reached the rock or the clay beneath."—HUXLEY *Lay Sermons*, serm. 14, p. 323. (G. P. P., 1899.)

906. DREAD OF THE IRREVOCABLE—*An Undecided Character.*—Against this impulse [to act and end suspense] we have the dread of the irrevocable, which often engenders a type of character incapable of prompt and vigorous resolve, except perhaps when surprised into sudden activity. These two opposing motives twine round whatever other motives may be present at the moment when decision is imminent, and tend to precipitate or retard it. The conflict of these motives so far as they alone affect the matter of decision is a conflict as to when it shall occur. One says "now," the other says "not yet."—JAMES *Psychology*, vol. ii, ch. 26, p. 530. (H. H. & Co., 1899.)

907. DREAM A BRIEF INSANITY—*Dreamer Has the Corrective of Waking—The Normal Mind Restored by Touch of External World.*—The parallelism between dreams and insanity has been pointed out by most writers on the subject. Kant observed that the madman is a dreamer awake, and more recently Wundt has remarked that, when asleep, we "can experience nearly all the phenomena which meet us in lunatic asylums." The grotesqueness of the combinations, the lack of all judgment as to consistency, fitness, and probability, are common characteristics of the short night-dream of the healthy and the long day-dream of the insane. But one great difference marks off the two domains. When dreaming, we are still sane, and shall soon prove our sanity. After all, the dream of the sleeper is corrected, if not so rapidly as the illusion of the healthy waker. As soon as the familiar stimuli of light and sound set the peripheral sense-organs in activity, and call back the nervous system to its complete round of healthy action, the illusion disappears, and we smile at our alarms and agonies, saying, "Behold, it was a dream!"—SULLY *Illusions*, ch. 7, p. 182. (A., 1897.)

908. DREAM-LIFE INFLUENCES OUR WAKING HOURS—Thus, Paul Radestock, in the work "Schlaf und Traum" [Sleep and Dream], tells us: "When I have been taking a walk, with my thoughts quite unfettered, the idea has often occurred to me that I had seen, heard, or thought of this or that thing once before, without being able to recall when, where, and in what circumstances. This happened at the time when, with a view to the publication of the present work, I was in the habit of keeping an exact record of my dreams. Consequently I was able to turn to this after these impressions, and on doing so I generally found the conjecture confirmed that I had previously dreamed something like it." Scientific inquiry is often said to destroy all beautiful thoughts about Nature and life; but while it destroys it creates. Is it not almost a romantic idea that just as our waking life images itself in our dreams, so our dream-life may send back some of its shadowy phantoms into our prosaic every-day world, touching this with something of its own weird beauty?—SULLY *Illusions*, ch. 10, p. 275. (A., 1897.)

909. DRUDGERY OF ENGINE-ROOM LESSENED—*The Mechanical Stoker.*—For a good many years mechanical stokers have been devised in various forms: they are steadily coming into favor in improved and economical types, completing the modernization of fuel-burning, and abolishing a most oppressive form of drudgery. As the automatic hopper, filled with fine coal, glides to and fro above a furnace provided with moving grate-bars, we behold the latest term of that marvelous advance which began when the savage first laboriously kindled a blaze to warm his hands or to cook his breakfast.—ILES *Flame, Electricity, and the Camera*, ch. 5, p. 6. (D. & McC., 1900.)

910. DUALISM OF PLATO AND MILL—*Calvinism Truer to Scientific Thought.*—Now in these strong assertions it seems to me that the Calvinist is much more nearly

in accord with our modern knowledge than are Plato and Mill. It is not wise to hazard statements as to what the future may bring forth, but I do not see how the dualism implied in all these attempts to refer good and evil to different creative sources can ever be seriously maintained again. The advance of modern science carries us irresistibly to what some German philosophers call monism, but I prefer to call it monotheism.—FISKE *Through Nature to God*, pt. i, ch. 4, p. 22. (H. M. & Co., 1900.)

911. DUALITY OF THE MIND—*A Beneficent Delusion.*—A gentleman of respectable birth, excellent education, and ample fortune, engaged in one of the highest departments of trade, . . . and being induced to embark in one of the plausible speculations of the day . . . was utterly ruined. Like other men, he could bear a sudden overwhelming reverse better than a long succession of petty misfortunes, and the way in which he conducted himself on the occasion met with unbounded admiration from his friends. He withdrew, however, into rigid seclusion, and being no longer able to exercise the generosity and indulge the benevolent feelings which had formed the happiness of his life, made himself a substitute for them by day-dreams, gradually fell into a state of irritable despondency, from which he only gradually recovered with the loss of reason. He now fancied himself possessed of immense wealth, and gave without stint his imaginary riches. He has ever since been under gentle restraint, and leads a life not merely of happiness, but of bliss; converses rationally, reads the newspapers, where every tale of distress attracts his notice, and being furnished with an abundant supply of blank checks, he fills up one of them with a munificent sum, sends it off to the sufferer, and sits down to his dinner with a happy conviction that he has earned the right to a little indulgence in the pleasures of the table; and yet, on a serious conversation with one of his old friends, he is quite conscious of his real position, but the conviction is so exquisitely painful that he will not let himself believe it.—WIGAN *Duality of the Mind*, quoted by JAMES in *Psychology*, vol. ii, ch. 26, p. 567. (H. H. & Co., 1899.)

912. DURATION OF LIFE OF ANTS—*Science Reverses Popular Estimate—Value of Experiment.*—I have already mentioned that the previous views as to the duration of life of ants turn out to be quite erroneous. It was the general opinion that they lived for a single year. Two of my queen ants lived, the one nearly fourteen, the other nearly fifteen years, viz., from December, 1874, to July, 1887, and August, 1888, respectively. During the whole time they enjoyed perfect health, and every year have laid eggs producing workers, a fact which suggests physiological conclusions of great interest. I have, moreover, little doubt that some of the workers now in this nest were among those originally captured, the mortality after the first few weeks having been but small. This, however, I cannot prove.—AVEBURY *Ants, Bees, and Wasps*, ch. 2, p. 41. (A., 1900.)

913. DURATIONS OF THE CELESTIAL PERIODS—*Millions of Ages Are But Seconds of the Eternal Clock.*—These durations of celestial periods exceed the ordinary idea of time which man has when he wonders at the age of a centenarian. These sidereal events, which are only reproduced after thousands of centuries, and which appear to us very rare occurrences, are, on the contrary, frequent phenomena of eternity. These periods of millions of ages are but the seconds of the eternal clock.—FLAMMARION *Popular Astronomy*, p. 45. (A.)

914. DUST A SOURCE OF BEAUTY AND FERTILITY—*Tints of Spring and Autumnal Skies—Rain Brings Fertility from Heaven.*—In spring we have a bluer sky and greater transparency of the atmosphere; in autumn, even on very fine days, there is always a kind of yellowish haze, resulting in a want of clearness in the air and purity of color in the sky. These phenomena are quite intelligible when we consider that during winter less dust is formed, and more is brought down to the earth by rain and snow, resulting in the transparent atmosphere of spring, while exactly opposite conditions during summer bring about the mellow autumnal light. Again, the well-known beneficial effects of rain on vegetation—as compared with any amount of artificial watering, tho no doubt largely due to the minute quantity of ammonia which the rain brings down with it from the air—must yet be partly derived from the organic or mineral particles which serve as the nuclei of every raindrop, and which, being so minute, are more readily dissolved in the soil and appropriated as nourishment by the roots of plants.—WALLACE *The Wonderful Century*, ch. 9, p. 84. (D. M. & Co., 1899.)

915. DUST MAKES PATH OF SUNBEAM VISIBLE—Every one has seen the floating dust in a sunbeam when sunshine enters a partially darkened room; but it is not generally known that if there was absolutely no dust in the air the path of the sunbeam would be totally black and invisible, while if only very little dust was present in very minute particles the air would be as blue as a summer sky.—WALLACE *The Wonderful Century*, ch. 9, p. 70. (D. M. & Co., 1899.)

916. DUST OF MOUNTAINS—*Glacier Grinds Rocks to Powder—Blue of Alpine Lake.*—The rocks over which glaciers pass are finely ground and pulverized by the ice, or the stony emery embedded in it; and the river which issues from the snout of every glacier is laden with suspended matter. When such glacier-water is placed in a tall

glass jar, and the heavier particles are permitted to subside, the liquid column, when viewed against a dark background, has a decidedly bluish tinge. The exceptional blueness of the Lake of Geneva, which is fed with glacier-water, may be due, in part, to particles small enough to remain suspended long after their larger and heavier companions have sunk to the bottom of the lake. —TYNDALL *Fragments of Science*, vol. i, ch. 5, p. 137. (A., 1897.)

917. DUST OF THE AIR PROVED TO BE ORGANIC—*Germs in the Air a Cause of Disease.*—It was Tyndall who first laid down the general principles upon which our knowledge of organisms in the air is based. That the dust in the air was mainly organic matter, living or dead, was a comparatively new truth; that epidemic disease was not due to "bad air" and "foul drains," but to germs conveyed in the air, was a prophecy as daring as it was correct. From these and other like investigations it came to be recognized that putrefaction begins as soon as bacteria gain an entrance to the putrefiable substance, that it progresses in direct proportion to the multiplication of bacteria, and that it is retarded when they diminish or lose vitality.—NEWMAN *Bacteria*, ch. 3, p. 101. (G. P. P., 1899.)

918. DUST ON HIGHEST MOUNTAINS—*Granular Snow or Névé.*—The névé is composed of stratified granular snow which is white or grayish white in color. The snow on high mountains is apt to be exceedingly fine, light, and dry when first formed; but by partial melting and refreezing it acquires a coarse, granular texture, much like compacted hail, and also becomes consolidated and hard. The surface of the névé is many times so softened by the warmth between summer storms that a thin crust of ice is formed when the temperature is again lowered. This crust is buried beneath the next succeeding snowfall and remains in the growing deposit as a thin stratum of ice. Névés are almost entirely free from stones or dirt, altho even on the highest mountains the dust borne from naked cliffs is widely spread over their surfaces and diminishes their brilliancy. This general dust-covering is frequently not noticeable until some really clean snow surface is brought in contrast with it. When a lake on the névé is drained and leaves a fresh surface of dazzling whiteness, the surrounding area frequently shows a gray tint by contrast, thus revealing the presence of dust which has been sprinkled over it. Sometimes the covering of dust, especially on the lower portions of the névés of Alpine glaciers, is sufficiently pronounced to form a definite division plane when buried by subsequent snowfalls. Illustrations of such an occurrence may frequently be seen in the walls of fissures.—RUSSELL *Glaciers of North America*, int., p. 4. (G. & Co., 1897.)

919. DUST ON THE HIGH SEAS—*Volcanic Products Carried Afar.*—The very finely divided volcanic dust is often borne to enormous distances from the volcano out of which it has been ejected. The force of the steam-current carrying the fragments into the atmosphere is often so great that they rise to the height of several miles above the mountain. Here they may actually pass into the upper currents of the atmosphere and be borne away to the distance of many hundreds or thousands of miles. Hence it is not an unusual circumstance for vessels at sea to encounter at great distances from land falling showers of this finely divided, volcanic dust.—JUDD *Volcanoes*, ch. 4, p. 71. (A., 1899.)

920. DUST, VOLCANIC—*Carried Round the World—Skies Long Reddened by Reflection—Eruption of Krakatau.*—A remarkable confirmation of this theory was given during the two or three years after the great eruption of Krakatau, near Java. The volcanic débris was shot up from the crater many miles high, and the heavier portion of it fell upon the sea for several hundred miles around, and was found to be mainly composed of very thin flakes of volcanic glass. Much of this was of course ground to impalpable dust by the violence of the discharge, and was carried up to a height of many miles. Here it was caught by the return current of air continually flowing northward and southward above the equatorial zone; and as these currents reach the temperate zone where the surface rotation of the earth is less rapid they continually flow eastward, and the fine dust was thus carried at a great altitude completely round the earth. Its effects were traced some months after the eruption in the appearance of brilliant sunset glows of an exceptional character, often flushing with crimson the whole western half of the visible sky. These glows continued in diminishing splendor for about three years, they were seen all over the temperate zone; and it was calculated that, before they finally disappeared, some of this fine dust must have traveled three times round the globe.—WALLACE *The Wonderful Century*, ch. 9, p. 77. (D. M. & Co., 1899.)

921. ——— ——— *Vast Quantity—Incalculable Minuteness.*—Mr. Whymper relates that, while standing on the summit of Chimborazo, he witnessed an eruption of Cotopaxi, which is distant more than fifty miles from the former mountain. The fine volcanic dust fell in great quantities around him, and he estimated that no less than two millions of tons must have been ejected during this slight outburst. Professor Bonney has examined this volcanic dust from Cotopaxi, and calculates that it would take from 4,000 to 25,000 particles to make up a grain in weight.—JUDD *Volcanoes*, ch. 4, p. 69. (A., 1899.)

922. DUTY TO HUMANITY—*Conquests of Science Belong to the Race.*—I hold it to be the duty of naturalists, not merely to meditate upon improvements and discoveries in the narrow circle to which their specialty confines them, not merely to pore over their one study with love and care, but also to seek to make the important general results of it fruitful to the mass, and to assist in spreading the knowledge of physical science among the people. The highest triumph of the human mind, the true knowledge of the most general laws of Nature, ought not to remain the private possession of a privileged class of learned men, but ought to become the common property of all mankind.—HAECKEL *History of Creation*, vol. i, ch. 1, p. 4. (K. P. & Co., 1899.)

923. DWELLINGS DEFENSIBLE—*Home of the Trap-door Spider.*—Trap-door spiders display the curious instinct of providing their nests with trap-doors. The nest consists of a tube excavated in the earth to the depth of half a foot or more. In all save one species the tube is unbranched; it is always lined with silk, which is continuous with the lining of the trap-doors, of which it forms the hinge. In the species which constructs a branching tube, the branch is always single, more or less straight, takes origin at a point situated a few inches from the orifice of the main tube, is directed upwards at an acute angle with that tube, and terminates blindly just below the surface of the soil. At its point of junction with or departure from the main tube it is provided with a trap-door resembling that which closes the orifice of the main tube, and of such a size and arrangement that when closed against the opening of the branch tube it just fills that opening; while when turned outwards, so as to uncork this opening, it just fills the diameter of the main tube: the latter, therefore, is in this species provided with two trap-doors, one at the surface of the soil, and the other at the fork of the branched tube.—ROMANES *Animal Intelligence*, ch. 6, p. 213. (A., 1899.)

924. DWELLINGS, ELEVATED, MOST HEALTHFUL—*Babylonians Built on Artificial Mounds.*—It was Hippocrates, head master of the art of healing, who pointed out that elevated situations are more advantageous as the site of dwellings than the low, and that the Babylonians who built in the valleys of rivers, or on other low ground, as a rule erected their dwellings upon artificial mounds.—ALSBERG *Die gesunde Wohnung.* (Translated for *Scientific Side-Lights.*)

925. DYING-PLACE OF A RACE—*The Huanacos' Golgotha.*—It is well known that at the southern extremity of Patagonia the huanacos have a dying-place, a spot to which all individuals inhabiting the surrounding plains repair at the approach of death to deposit their bones. Darwin and Fitzroy first recorded this strange instinct in their personal narratives, and their observations have since been fully confirmed by others. The best known of these dying- or burial-places are on the banks of the Santa Cruz and Gallegos rivers, where the river valleys are covered with dense primeval thickets of bushes and trees of stunted growth; there the ground is covered with the bones of countless dead generations. "The animals," says Darwin, "in most cases must have crawled, before dying, beneath and among the bushes." A strange instinct in a creature so preeminently social in its habits: a dweller all its life long on the open, barren plateaux and mountainsides! What a subject for a painter! The gray wilderness of dwarf thorn-trees, aged and grotesque and scanty-leaved, nourished for a thousand years on the bones that whiten the stony ground at their roots; the interior lit faintly with the rays of the departing sun, chill and gray, and silent and motionless—the huanacos' Golgotha.—HUDSON *Naturalist in La Plata*, ch. 21, p. 316. (C. & H., 1895.)

926. EARNESTNESS OF SCIENCE—*Reaching toward the Infinite.*—The great and solemn spirit that pervades the intellectual labor [of science] arises from the sublime consciousness of striving toward the infinite, and of grasping all that is revealed to us amid the boundless and inexhaustible fulness of creation, development, and being. This active striving, which has existed in all ages, must frequently, and under various forms, have deluded men into the idea that they had reached the goal, and discovered the principle which could explain all that is variable in the organic world, and all the phenomena revealed to us by sensuous perception.—HUMBOLDT *Cosmos*, vol. iii, p. 11. (H., 1897.)

927. EARTH A MAGNET—*Revolution of Magnetic Pole.*—One of the striking exhibitions of magnetism is found in the earth. The earth itself is a great magnet; and there is good reason for believing that it is an electromagnet of great power. The magnetic poles of the earth are not exactly coincident with the geographical poles, and they are not constant. There is a gradual deviation going on, but as it follows a certain law mariners are able to tell just what the deviation should be at a certain time. The magnetic pole revolves around the polar axis of the earth once in about 320 years.—ELISHA GRAY *Nature's Miracles*, vol. iii, ch. 4, p. 32. (F. H. & H., 1900.)

928. EARTH AS VIEWED FROM WITHOUT—*An Imaginary Description by a Scientist of the Moon.*—The academicians of the moon doubtless say, in their turn, with an assurance no less convinced, "The earth is composed of elements dissimilar and very extraordinary. One, which forms the nucleus of the body and which gives birth to fixed spots, appears to have some consist

ency; but it is covered with another element, of a strange constitution, which appears to have neither body, nor stability, nor continuance. It has neither color nor density. It takes all forms, moves in all directions, obeys all shocks, submits to all impulses, is extended, contracted, condensed, appears and disappears, without our being able to imagine such strange metamorphoses. This is the world of instability, the planet of revolutions. It experiences in turn all imaginable disasters. It seems to be matter in fermentation, which tends to dissolve. We only see storms, cyclones, whirlwinds, and acts of violence of all sorts. They assert that there are inhabitants on this planet; but on what point can they live? Is it on the solid element of the body? They would be crushed, suffocated, asphyxiated, drowned by that element which weighs on them from all sides. Is it through the openings in this mobile curtain that they can enjoy, as we do, the pure ether of the heavens? But how can we suppose that they might not at any moment be torn from the soil by the violence of the disorders which torment the surface? Do they wish to place them on the light and mobile stratum which hides from us so often the aspect of the terrestrial nucleus? How can they be maintained upright on this element without solidity? . . . There is no necessity for long consideration to prove conclusively that this planet is very vast, but that it is no place for animated beings. The whole earth is not worth the soul of a single Selenite. If, however, they will insist that it may have inhabitants, we will consent with pleasure, provided that they compare them with fantastic beings floating at the pleasure of all the forces which contend with each other on this aeriform planet. There can only exist there rather coarse animals. Such are, in our opinion, the only inhabitants which can people the earth."

The scientists of the moon have, as we see, the ability to prove, in the most categorical manner, to the ignorant who surround them, that the earth, not being habitable, should not be inhabited, and that it is made solely to serve as a clock to the moon and to shine during the night.—FLAMMARION *Popular Astronomy*, bk. ii, ch. 6, p. 159. (A.)

929. EARTH, CONVULSIONS OF—*Ancient and Modern Catastrophes Compared.*—We know that subterranean movements and volcanic eruptions are often attended not only by incursions of the sea, but also by violent rains, and the complete derangement of the river-drainage of the inland country, and by the damming up of the outlets of lakes by landslips, or obstructions in the courses of subterranean rivers, such as abound in Thessaly and the Morea. We need not therefore be surprised at the variety of causes assigned for the traditional floods of Greece, by Herodotus, Aristotle, Diodorus, Strabo, and others. As to the area embraced, had all the Grecian deluges occurred simultaneously, instead of being spread over many centuries, and had they, instead of being extremely local, reached at once from the Euxine to the southwestern limit of the Peloponnesus, and from Macedonia to Rhodes, the devastation would still have been more limited than that which visited Chile in 1835, when a volcanic eruption broke out in the Andes, opposite Chiloe, and another at Juan Fernandez, distant 720 geographical miles, at the same time that several lofty cones in the Cordillera, 400 miles to the eastward of that island, threw out vapor and ignited matter. Throughout a great part of the space thus recently shaken in South America, cities were laid in ruins, or the land was permanently upheaved, or mountainous waves rolled inland from the Pacific.—LYELL *Principles of Geology*, bk. ii, ch. 22, p. 357. (A., 1854.)

930. EARTH, COOLING AND CONTRACTION OF—*Earthquakes and Volcanoes Mightier in Early Times.*—The general result which we should arrive at would be that in past ages the loss of heat was more rapid than it is at present. Now the contraction of a body as it cools is for low temperatures proportional to its loss of heat, and this law is also probably true for contraction as it takes place from high temperatures. Contraction of the earth's nucleus being more rapid than it is at present, it is probable that phenomena like elevations and depressions would be more rapid than they are at present, and generally all changes due to Plutonic action, as has already been pointed out by Lord Kelvin (Sir William Thomson), must have been more frequent and intense than they are at the present day. We have, therefore, every reason to imagine that earthquakes which belong to the category of phenomena here referred to were also numerous and occurred on a grander scale during the earlier stages of the world's history than they do at present, and seismic and volcanic energy, when considered in reference to long periods of time, is probably a decreasing energy.—MILNE *Earthquakes*, ch. 13, p. 236. (A., 1899.)

931. EARTH, DESTRUCTION AND RENOVATION OF ITS SURFACE—*Theory of Aristotle.* — When we consider the acquaintance displayed by Aristotle, in his various works, with the destroying and renovating powers of Nature, the introductory and concluding passages of the twelfth chapter of his "Meteorics" are certainly very remarkable. In the first sentence he says, "The distribution of land and sea in particular regions does not endure throughout all time, but it becomes sea in those parts where it was land, and again it becomes land where it was sea: and there is reason for thinking that these changes take place according to a certain system, and within a certain period." The concluding observation

is as follows: "As time never fails, and the universe is eternal, neither the Tanais nor the Nile can have flowed forever. The places where they rise were once dry, and there is a limit to their operations; but there is none to time. So also of all other rivers; they spring up, and they perish; and the sea also continually deserts some lands and invades others. The same tracts, therefore, of the earth are not some always sea, and others always continents, but everything changes in the course of time."—LYELL *Principles of Geology*, bk. i, ch. 2, p. 13. (A., 1854.)

932. EARTH, ELEVATION AND SUBSIDENCE OF—*Slow Movement through Centuries.*—Lyell estimated that the average rate of rise in Scandinavia has been about two and a half feet per century. At the North Cape the rise may have been as much as five or six feet per century. Observations made at the temple of Jupiter Serapis, between October, 1822, and July, 1838, showed that the ground was sinking at the rate of about one inch in four years. Since the Roman period, when this temple was built, the ground has sunk twenty feet below the waves. Now the floor of the temple is on the level of the sea. Lyell remarks that if we reflect on the dates of the principal oscillations at this place there appears to be connection between the movements of upheaval and a local development of volcanic heat, whilst periods of depression are concurrent with periods of volcanic quiescence.—MILNE *Earthquakes*, ch. 21, p. 351. (A., 1899.)

933. EARTH ENRICHED BY MATERIALS FROM AFAR—*Matter from Distant Space Continually Drawn In.*—Let it suffice that we recognize, as one of the earliest stages of our earth's history, her condition as a rotating mass of glowing vapor, capturing then as now, but far more actively then than now, masses of matter which approached near enough, and growing by these continual indrafts from without. From the very beginning, as it would seem, the earth grew in this way. This firm earth on which we live represents an aggregation of matter not from one portion of space, but from all space. All this is upon and within the earth, all vegetable forms and all animal forms, our bodies, our brains, are formed of materials which have been drawn in from those depths of space surrounding us on all sides. This hand that I am now raising contains particles which have traveled hither from regions far away amid the northern and southern constellations, particles drawn in towards the earth by processes continuing millions of millions of ages, until after multitudinous changes the chapter of accidents has so combined them, and so disturbed them in plants and animals, that after coming to form portions of my food they are here present before you. Passing from the mere illustration of the thought, is not the thought itself striking and suggestive, that not only the earth on which we move, but everything we see or touch, and every particle in body and brain, has sped during countless ages through the immensity of space?—PROCTOR *Our Place among Infinities*, p. 9. (L. G. & Co., 1897.)

934. EARTH FEELS CHANGES ON SUN—*Cosmic Influence—Auroras Follow Variation of Sun-spots.*—The relation between the aurora borealis and the sun-spots was studied and finally proved by Fritz, Loomis, and Lovering. Fritz appears to have been the first who distinctly laid down the law that the number and importance of the auroras follow exactly the same variation as the spots on the sun, so that the epochs of the maxima and minima coincide almost exactly for the two orders of phenomena.—ANGOT *Aurora Borealis*, ch. 5, p. 96. (A., 1897.)

935. EARTH FORMING STILL—*Ceaseless Circulation of the Solid Materials of the Globe.*—Over every part of the earth's surface these three grand operations of the disintegration of old rock-masses, the transport of the materials so produced to lower levels, and the accumulation of these materials to form new rocks, are continually going on. It is by the varied action of these denuding agents upon rocks of unequal hardness, occupying different positions in relation to one another, that all the external features of hills, and plains, and mountains owe their origin.—JUDD *Volcanoes*, ch. 10, p. 284. (A., 1899.)

936. EARTH HELD TO BE A GREAT METEORITE—But in recent years a number of very important facts have been discovered which may well lead us to devote a closer attention to the composition and structure of meteorites. It has been shown, on the one hand, that some meteorites contain substances precisely similar to those which are sometimes brought from the earth's interior during volcanic outbursts; and, on the other hand, there have been detected, among some of the ejections of volcanoes, bodies which so closely resemble meteorites that they were long mistaken for them. Both kinds of observation seem to point to the conclusion that the earth's interior is composed of similar materials to those which we find in the small planets called meteorites.—JUDD *Volcanoes*, ch. 11, p. 315. (A., 1899.)

937. EARTH, HUMAN DWELLINGS ENGULFED IN—*Fissures Opened and Closed in Earthquake.*—Almost all large earthquakes have produced cracks in the ground. The cracks which were found in the ground at Yokohama (February 22, 1880) were about two or three inches wide, and from twenty to forty yards in length. They could be best seen as lines along a road running near the upper edge of some cliffs which overlook the sea at that place. The reason

that cracks should have occurred in such a position rather than in others was probably owing to the greater motion at such a place, due to the face of the cliff being unsupported, and there being no resistance opposed to its forward motion. It often happens that earthquake cracks are many feet in width. At the Calabrian earthquake of 1783, one or two of the crevasses which were formed were more than 100 feet in width and 200 feet in depth. Their lengths varied from half a mile to a mile. Besides these large cracks, many smaller ones of one or two feet in breadth and of great length were formed. In the large fissures many houses were engulfed. Subsequent excavations showed that by the closing of the fissures these had been jammed together to form one compact mass.—MILNE *Earthquakes*, ch. 8, p. 147. (A., 1899.)

938. EARTH, LONG DURATION OF —*Coral Reefs Require Vast Periods of Time —Contrasted Brevity of Human Life.*—The evidence capable of being adduced from the growth of coral reefs goes far to prove the constant and uniform state of our earth throughout immense periods of time. The testimony of Mr. Dana with regard to the rate at which coral grows is to the effect that the massive corals on which the increase of reef depends are of very slow growth; the branching and certain other kinds growing at a faster rate. One-eighth of an inch per year is given by this author as "the average upward increase of the whole reef-ground per year"; and the estimate appears to be a perfectly just one, when judged by the evidence afforded us of the rate of growth in corals. All authorities agree in stating the growth of massive corals at a very low rate, and the time which has been occupied in the formation of a reef 2,000 feet thick must, therefore, on Mr. Dana's estimate, be set down at 192,000 years. This computation, it must be remembered, is one dealing with the work of modern corals. In the far-back past, coral reefs existed similar in every respect to their modern representatives; these fossil reefs in many cases evincing an immense thickness. Hence we are led to believe that, notwithstanding the alteration which our earth has undergone, it has had prolonged periods of rest; and the existence of a modern coral reef may therefore afford evidence, not only of the immensity of past time, but also of the uniformity of Nature's ways and works during periods compared with which the farthest limits of history and even of man's own age are but as yesterday.—WILSON *Facts and Fictions of Zoology*, p. 43. (Hum., 1882.)

939. EARTH LOSING HEAT—*Change and Upbuilding of Surface to Cease—The Planet's Old Age.*—The earth's nuclear regions are parting with their heat, and as they cannot part with their heat without warming the surface-crust, which nevertheless grows no warmer, we perceive that the surface-heat is maintained from a source which is being gradually exhausted. The fitness of the earth to be the abode of life will not only be affected directly in this way, but will be indirectly affected by the loss of that Vulcanian energy which appears to be one of its necessary conditions. At present, the surface of the earth is like the flesh clothing the living body; it does not wear out because (through the life which is within it) it undergoes continual change. But even as the body itself is consumed by natural processes so soon as life has passed from it, so when the internal heat of the earth, which is its life, shall have passed away, her surface will "grow old as doth a garment" (Ps. cii, 26); and with this inherent terrestrial vitality will pass away by slow degrees the life which is upon the earth.—PROCTOR *Our Place among Infinities*, p. 28. (L. G. & Co., 1897.)

940. EARTH ONCE A MOLTEN MASS —There was a time when our earth was in a state of igneous fusion, when no ocean bathed it and no atmosphere surrounded it, when no wind blew over it and no rain fell upon it, but an intense heat held all its materials in solution. In those days the rocks which are now the very bones and sinews of our mother earth—her granites, her porphyries, her basalts, her syenites—were melted into a liquid mass. — AGASSIZ *Geological Sketches*, ser. i, ch. 1, p. 2. (H. M. & Co., 1896.)

941. EARTH, THE FINISHING OF, FOR MAN—The work of the artist is not yet finished when his statue is blocked out and the grand outline of his conception stands complete: and there still remained, after the earth was rescued from the water, after her framework of mountains was erected, after her soil was clothed with field and forest, processes by which her valleys were to be made more fruitful, her gulfs to be filled with the rich detritus poured into them by the rivers, her whole surface to be rendered more habitable for the higher races who were to possess it.—AGASSIZ *Geological Sketches*, ser. i, ch. 7, p. 204. (H. M. & Co., 1896.)

942. EARTH UNINHABITABLE WITHOUT BIRDS—*Our Unconsidered Indebtedness.*—If we were deprived of the services of birds [in the destruction of insects], the earth would soon become uninhabitable. Nevertheless, the feathered protectors of our farms and gardens, plains and forests, require so little encouragement from us—indeed, ask only tolerance—that we accept their services much as we do the air we breathe. We may be in debt to them past reckoning, and still be unaware of their existence.—CHAPMAN *Bird-Life*, ch. 1, p. 9. (A., 1900.)

943. EARTH'S ANCIENT COMPANION—*The Moon an Object of Unique Interest to Man.*—The moon possesses for us an

unique interest. She in all probability shared the origin of the earth; she perhaps profigures its decay. She is at present its minister and companion. Her existence, so far as we can see, serves no other purpose than to illuminate the darkness of terrestrial nights, and to measure, by swiftly recurring and conspicuous changes of aspect, the long span of terrestrial time. Inquiries stimulated by visible dependence, and aided by relatively close vicinity, have resulted in a wonderfully minute acquaintance with the features of the single lunar hemisphere open to our inspection.—CLERKE *History of Astronomy*, pt. ii, ch. 7, p. 322. (Bl., 1893.)

944. EARTH'S GIRDLE—*Electric Telegraph—Submarine Lines of Telegraph.*—About the middle of the last century it was perceived by a few students of electricity that it afforded a means of communication at a distance; but it was not till the year 1837 that the efforts of many simultaneous workers overcame the numerous practical difficulties, and the first electric telegraph was established. Its utility was so great, especially in the working of the railways then being rapidly extended over the kingdom, that it soon came into general use. The first submarine line was laid from Dover to Calais in 1851; and only five years afterward, in 1856, a company was formed to lay an electric cable across the Atlantic. The cable, 2,500 miles long and weighing a ton per mile, was successfully laid, in 1858, from Ireland to Newfoundland; but owing to the weakness of the electric current, and perhaps to imperfections in the cable, it soon became useless, and had to be abandoned. After eight years more of invention and experiment, another cable was successfully laid in 1866; and there are now no less than fourteen lines across the Atlantic, while all the other oceans have been electrically bridged, so that messages can be sent to almost any part of the globe at a speed which far surpasses the imaginary power of Shakespeare's sprite Ariel, who boasted that he could "put a 'girdle round about' the earth in forty minutes"—WALLACE *The Wonderful Century*, ch. 3, p. 21. (D. M. & Co., 1899.)

945. EARTH'S RETURNING FRAGMENTS—*Meteorites Perhaps of Earthly Origin.*—Well, these stones from the sky being of the same composition as the minerals of which our own planet is formed, is it not natural to ask simply whether they may not have had the earth itself for their origin? But how? May not the violent volcanoes of geological times, the eruptions, the tremendous conflagrations, the fierce fires of the ancient pandemonium, have shot into space lava, scoria, stones, with such a force of projection that these objects would be despatched to thousands, millions, hundreds of millions of miles, in orbits which would not take less than a thousand, ten thousand, a hundred thousand years or more to describe? If our planet has been able to give birth to such projectiles, it does not form an exception in the universe, and the other celestial bodies may be in the same case. Thus, the sun itself is seen to be almost constantly surrounded with tremendous metallic gaseous eruptions, which are shot out to thousands and even hundreds of thousands of miles above its surface. This is the most rational hypothesis. Such eruptions may take place on all worlds. However, the terrestrial eruptions would make the products return to us, whereas the others would be sent in all directions. Moreover, the identity of structure of most of the uranoliths with terrestrial minerals presents itself as an eloquent witness in favor of this hypothesis, which may be summed up thus:

Most of the stones which fall from the sky may be natives of the earth itself, having been projected into space by the volcanic eruptions of geological times.—FLAMMARION *Popular Astronomy*, bk. v, ch. 4, p. 549. (A.)

946. EARTH'S SWIFT REVOLUTION—*The Sun's Ceaseless Control.*—If the earth could be suddenly stopped in her orbit, and allowed to fall unobstructed toward the sun under the accelerating influence of his attraction, she would reach the center in about two months. I have said if she could be stopped, but such is the compass of her orbit that, to make its circuit in a year, she has to move nearly 19 miles a second, or more than fifty times faster than the swiftest rifle-ball; and in moving 20 miles her path deviates from perfect straightness by less than one-eighth of an inch. And yet, over all the circumference of this tremendous orbit, the sun exercises his dominion, and every pulsation of his surface receives its response from the subject earth.—YOUNG *The Sun*, ch. 1, p. 37. (A., 1898.)

947. EARTH-CRUST AFLOAT ON A PLASTIC OCEAN—*The Solid Center Has Different Revolution.*—Nevertheless, inasmuch as solidification would occur at the surface, where the radiation of heat would take place most rapidly, and as the descending solid matter would be gradually liquefied, it seems certain that for a long time the solid portions of the earth, tho not forming a solid crust, would occupy the exterior parts of the earth's globe. After a time, the whole globe would have so far cooled that a process of aggregation of solid matter around the center of the earth would take place. The matter so aggregated consisted probably of metallic and metalloidal compounds denser than the material forming the crust of the earth. Between the solid center and the solidifying crust there would be a shell of uncongealed matter, gradually diminishing in amount, but a portion probably retaining its liquid condition even to the present time, whether existing in isolated reservoirs, or whether, as Scrope opines, it forms still a continuous sheet sur-

rounding the solid nucleus. One strange fact of terrestrial magnetism may be mentioned in partial confirmation of the theory that the interior of the earth is of this nature—a great solid mass, separated from the solid crust by a viscous plastic ocean: the magnetic poles of the earth are changing in position in a manner which seems only explicable on the supposition that there is an interior solid globe rotating under the outer shell, but at a slightly different rate, gaining or losing one complete rotation in the course of about 650 years.—PROCTOR *Our Place among Infinities*, p. 17. (L. G. & Co., 1897.)

948. EARTH-CRUST, CHANGES IN, CEASELESS—However constant may be the relative proportion of sea and land, we know that there is annually some small variation in their respective geographical positions, and that in every century the land is in some parts raised, and in others depressed in level, and so likewise is the bed of the sea. By these and other ceaseless changes, the configuration of the earth's surface has been remodeled again and again, since it was the habitation of organic beings, and the bed of the ocean has been lifted up to the height of some of the loftiest mountains.—LYELL *Principles of Geology*, bk. i, ch. 7, p. 102. (A., 1854.)

949. ——— ——— *Not Alarming—Relative Insignificance of Mountain Height.*—The imagination is apt to take alarm when called upon to admit the formation of such irregularities in the crust of the earth, after it had once become the habitation of living creatures; but, if time be allowed, the operation need not subvert the ordinary repose of Nature; and the result is in a general view insignificant, if we consider how slightly the highest mountain chains cause our globe to differ from a perfect sphere. Chimborazo, tho it rises to more than 21,000 feet above the sea, would be represented, on a globe of about six feet in diameter, by a grain of sand less than one-twentieth of an inch in thickness.

The superficial inequalities of the earth, then, may be deemed minute in quantity, and their distribution at any particular epoch must be regarded in geology as temporary peculiarities, like the height and outline of the cone of Vesuvius in the interval between two eruptions. But altho, in reference to the magnitude of the globe, the unevenness of the surface is so unimportant, it is on the position and direction of these small inequalities that the state of the atmosphere, and both the local and general climate, are mainly dependent.—LYELL *Principles of Geology*, bk. i, ch. 7, p. 102. (A., 1854.)

950. EARTH-CRUST UNDERMINED —*Caverns—Subterranean Rivers.*—In countries where calcareous rocks largely predominate, acidulated water filtering down from the surface through fissures and other division-planes has often licked out a complicated series of tortuous tunnels and galleries. So far has this process been carried on in some regions that the whole rainfall finds its way into subterranean courses, and the entire drainage of the land is conducted underground. The dimensions attained by many well-known limestone caverns, and the great width and depth of the channels through which subterranean rivers reach the sea, help us to appreciate the amount of rock-material which underground water is capable of removing. From the surface of certain regions hundreds of feet of various calcareous rocks have thus been gradually removed; while in other cases the contour of the ground has been notably affected by the collapse of underground channels and chambers.—GEIKIE *Earth Sculpture*, ch. 2, p. 31. (G. P. P., 1898.)

951. EARTH-LIGHT ON THE MOON —*The "Ashy Light"—Earth Sees Herself in the Mirror of the Moon.*—When the moon is a crescent, during the first days of the lunation, we notice that the rest of the lunar globe is visible, illuminated by a pale light. This is the *lumière cendrée* [the ashy light]. It is caused by the earth itself.

In fact, the earth is illuminated by the sun, and reflects the light into space. When the moon is in conjunction with the sun the earth is in "opposition," as seen from the moon; it is the epoch of full earth for an observer on our satellite. The light which our globe then sends to the moon exceeds about fourteen times that which the full moon sends to us. This ashy light, reflection of a reflection, resembles a mirror in which we may see the luminous state of the earth. In winter, when a great part of the terrestrial hemisphere is covered with snow, it is perceptibly brighter. Before the geographical discovery of Australia, astronomers suspected the existence of that continent from the ashy light, which was very much brighter than could be produced by the dark reflection from the ocean. This lunar light generally presents a greenish-blue tint, indicating that our planet, seen from a distance, would show this shade.—FLAMMARION *Popular Astronomy*, bk. ii, ch. 2, p. 99. (A.)

952. EARTHQUAKE CHANGING LEVEL OF GROUND—*Houses and Persons Engulfed in Fissures.*—The soil of the Calabrian plains was found to be in some parts abnormally raised, in others as strangely depressed. "In the town of Terranova," says Sir Charles Lyell, "some houses were seen uplifted above the common level, and others adjoining sunk down into the earth. In several streets the soil appeared thrust up, and abutted against the walls of houses; a large circular tower of solid masonry, part of which withstood the general destruction, was divided by a circular rent, and one side was upraised, and the foundations heaved out of the ground." As might be expected, the soil did not continue unbroken by the

violent shocks to which it was subjected. In the central parts of the disturbed region the earth opened so widely as to swallow up large houses. In Cannamaria many buildings were "completely engulfed in one chasm," insomuch that not a trace of them was ever seen afterward. So violently did these chasms close their yawning jaws, that afterward, when excavations were made for the recovery of valuables, the workmen found the contents of houses crushed into a compact mass with detached portions of masonry. In some instances persons were engulfed by one shock and thrown out again alive by the following one.—PROCTOR *Notes on Earthquakes*, p. 3. (Hum., 1887.)

953. EARTHQUAKE DESOLATING WIDE DISTRICT—*Destruction, Sudden, Swift, and without Warning—Man Powerless in Grasp of Elemental Forces.*—One of the most remarkable earthquakes ever experienced was that which overthrew Riobamba on February 4, 1797. A district 120 miles long and 60 broad was shaken by an undulatory motion which lasted for four minutes, and a far wider district felt the effects of the disturbance. Within the space first named, in which the movement was more energetic, every town and village was leveled to the ground; and many places were buried under large masses flung down from the surrounding mountains. Among these was the flourishing town of Riobamba. Preceded and accompanied by no warning noises whatever, the terrific concussion in a few moments effected the complete desolation of the unhappy district. The earthquake was a singular combination of perpendicular, horizontal, and rotary vibrations. So violent was the perpendicular, or as it may be termed the explosive, movement, that hundreds of the wretched inhabitants were flung upon the hill La Culla, several hundred feet high, on the further side of the small river Lican. Then came a horizontal movement, so rapidly succeeding the other that in many instances the furniture of one house was found beneath the ruins of another. In some cases property was removed so far from its original place, that disputes arose among the survivors of the catastrophe, and the *Audiencia*, or court of justice, was for some time occupied in adjusting these difficulties. Not less remarkable were the effects of circular or rotary concussions. Walls beyond the town were twisted round without being flung down; rows of trees which had been parallel were deflected in the most remarkable manner; and the direction of the ridges of fields covered with various kinds of grain was observed to be altered by the effects of the earthquake.—PROCTOR *Notes on Earthquakes*, p. 4. (Hum., 1887.)

954. EARTHQUAKE IN THE MISSISSIPPI VALLEY—*Waves Traversing the Earth-crust—Chasms Opening Far and Wide—South Carolina and New Madrid, Missouri, 1811-12.*—Previous to the destruction of La Guayra and Caracas, in 1812, earthquakes were felt in South Carolina; and the shocks continued till those cities were destroyed. The valley also of the Mississippi, from the village of New Madrid to the mouth of the Ohio in one direction, and to the St. Francis in another, was convulsed in such a degree as to create new lakes and islands. It has been remarked by Humboldt in his "Cosmos," that the earthquake of New Madrid presents one of the few examples on record of the incessant quaking of the ground for several successive months far from any volcano. Flint, the geographer, who visited the country seven years after the event, informs us that a tract of many miles in extent, near the Little Prairie, became covered with water three or four feet deep; and when the water disappeared a stratum of sand was left in its place. Large lakes of twenty miles in extent were formed in the course of an hour, and others were drained. The graveyard at New Madrid was precipitated into the bed of the Mississippi; and it is stated that the ground whereon the town is built, and the river-bank for fifteen miles above, sank eight feet below their former level. The neighboring forest presented for some years afterwards "a singular scene of confusion; the trees standing inclined in every direction, and many having their trunks and branches broken."

The inhabitants relate that the earth rose in great undulations; and when these reached a certain fearful height, the soil burst, and vast volumes of water, sand, and pit-coal were discharged as high as the tops of the trees. Flint saw hundreds of these deep chasms remaining in an alluvial soil, seven years after. The people in the country, altho inexperienced in such convulsions, had remarked that the chasms in the earth were in a direction from southwest to northeast; and they accordingly felled the tallest trees, and laying them at right angles to the chasms, stationed themselves upon them. By this invention, when chasms opened more than once under these trees, several persons were prevented from being swallowed up. At one period during this earthquake, the ground not far below New Madrid swelled up so as to arrest the Mississippi in its course, and to cause a temporary reflux of its waves. The motion of some of the shocks is described as having been horizontal, and of others perpendicular; and the vertical movement is said to have been much less desolating than the horizontal.—LYELL *Principles of Geology*, bk. ii, ch. 27, p. 466. (A., 1854.)

955. EARTHQUAKE SHAKES MAN'S CONFIDENCE IN THE ORDER OF NATURE—*"The Solid Earth" Proved a Delusion.*—The deep and peculiar impression left on the mind by the first earthquake which we experience . . . is not, in my opinion, the result of a recollection of those fearful

pictures of devastation presented to our imaginations by the historical narratives of the past, but is rather due to the sudden revelation of the delusive nature of the inherent faith by which we had clung to a belief in the immobility of the solid parts of the earth. We are accustomed from early childhood to draw a contrast between the mobility of water and the immobility of the soil on which we tread; and this feeling is confirmed by the evidence of our senses. When, therefore, we suddenly feel the ground move beneath us, a mysterious and natural force, with which we are previously unacquainted, is revealed to us as an active disturbance of stability. A moment destroys the illusion of a whole life; our deceptive faith in the repose of Nature vanishes, and we feel transported, as it were, into a realm of unknown destructive forces. Every sound—the faintest motion in the air—arrests our attention, and we no longer trust the ground on which we stand. Animals, especially dogs and swine, participate in the same anxious disquietude; and even the crocodiles of the Orinoco, which are at other times as dumb as our little lizards, leave the trembling bed of the river, and run with loud cries into the adjacent forests. To man the earthquake conveys an idea of some universal and unlimited danger. We may flee from the crater of a volcano in active eruption, or from the dwelling whose destruction is threatened by the approach of the lava stream; but in an earthquake, direct our flight whithersoever we will, we still feel as if we trod upon the very focus of destruction.—HUMBOLDT *Cosmos*, vol. i, p. 215. (H., 1897.)

956. EARTHQUAKE'S WIDE-REACHING EFFECT—*Vast Destruction of Human Life.*—The great earthquake which destroyed the city of Lisbon on the 1st of November, 1755, was felt in the Alps, on the coast of Sweden, in the Antilles, Antigua, Barbados, and Martinique; in the great Canadian Lakes, in Thuringia, in the flat country of Northern Germany, and in the small inland lakes on the shores of the Baltic. Remote springs were interrupted in their flow, a phenomenon attending earthquakes which had been noticed among the ancients by Demetrius the Callatian. The hot springs of Töplitz dried up, and returned, inundating everything around, and having their waters colored with iron ocher. In Cadiz the sea rose to an elevation of sixty-four feet, while in the Antilles, where the tide usually rises only from twenty-six to twenty-eight inches, it suddenly rose above twenty feet, the water being of an inky blackness. It has been computed that on the 1st of November, 1755, a portion of the earth's surface, four times greater than that of Europe, was simultaneously shaken. As yet there is no manifestation of force known to us, including even the murderous inventions of our own race, by which a greater number of people have been killed in the short space of a few minutes: sixty thousand were destroyed in Sicily in 1693, from thirty to forty thousand in the earthquake of Riobamba in 1797, and probably five times as many in Asia Minor and Syria, under Tiberius and Justinian the elder, about the years 19 and 526.—HUMBOLDT *Cosmos*, vol. i, p. 211. (H., 1897.)

957. EARTHQUAKES, BENEFICENT EFFECTS OF—*Continents Maintained by Their Reproductive Power—Good from Seeming Evil.*—But for earthquakes our continents would continually—however slowly—diminish in extent through the action of the sea-waves upon their borders, and of rain and rivers on their interior surfaces. "Had the primeval world been constructed as it now exists," says Sir John Herschel, "time enough has elapsed, and force enough, directed to that end, has been in activity, to have long ago destroyed every vestige of land." It is to the reproductive energy of the earth's internal forces that we are alone indebted for the very existence of dry land. To the same cause, undoubtedly, we owe that gradual process of change in the configuration of continents and oceans which has been for ages and still is in progress—a process the benefit derived from which cannot possibly be called in question. Our forests and our fields derive their nourishment from soils prepared, for long ages, beneath the waves of ocean; our stores of coal and of many other important minerals have been in like manner prepared for our use during the long intervals of their submergence; we build our houses even with materials many of which owe their perfect adaptation to our wants to the manner in which they have been slowly deposited on what was once the bed of ocean, and compressed to a due solidity and firmness of texture beneath its depths. . . . So far from dreading lest the earth's subterranean forces should acquire new energies, we ought rather to fear lest they should lose their force.—PROCTOR *Notes on Earthquakes*, p. 6. (Hum., 1887.)

958. EARTHQUAKES, JAPANESE BUILDINGS UNHARMED BY—*Peril Accepted as a Common Incident of Life.*—The ordinary Japanese house consists of a light framework of 4- or 5-inch scantling, built together without struts or ties, all the timbers crossing each other at right angles. The spaces are filled in with wattlework of bamboo, and this is plastered over with mud. This construction stands on the top of a row of boulders or of square stones, driven into the surface soil to a distance varying from a few inches to a foot. The whole arrangement is so light that it is not an uncommon thing to see a large house rolled along from one position to another on wooden rollers. In buildings such as these, after a series of small earthquake shocks, we could hardly expect to find more fractures than in a wicker basket. . . . So far as my own experience has gone, I must

say that I have never seen any signs in the Japanese timber buildings which could be attributed to the effects of earthquakes, and His Excellency Yamao Yozo, Vice-Minister of Public Works, who has made the study of the buildings of Japan a speciality, told me that none of the temples and palaces, altho many of them are several centuries old, and altho they have been shaken by small earthquakes and also by many severe ones, show any signs of having suffered. The greatest damage wrought by large earthquakes appears to have resulted from the influx of large waves or from fires.—MILNE *Earthquakes*, ch. 7, p. 122. (A., 1899.)

959. EARTH-SCULPTURE OF PRIMITIVE MAN—*"Animal Mounds"—The "Alligator."*—The "Animal Mounds" which have been observed out of Wisconsin differ in many respects from the ordinary type. Near Granville, in Ohio, on a higher spur of land, is an earthwork, known in the neighborhood as the "Alligator." It has a head and body, four sprawling legs, and a curled tail. The total length is two hundred and fifty feet; the breadth of the body forty feet, and the length of the legs thirty-six feet. "The head, shoulders, and rump are more elevated than the other parts of the body, an attempt having evidently been made to preserve the proportions of the object copied." The average height is four feet, at the shoulders six.—AVEBURY *Prehistoric Times*, ch. 8, p. 256. (A., 1900.)

960. ECHOES OF THOUGHT—*After-images—Each Perception or Sensation Leaves Its Trace—Counting Strokes after Clock Has Struck.*—In the nervous system each stimulus leaves some latent activity behind it which only gradually passes away. Psychological proof of the same fact is afforded by those "after-images" which we perceive when a sensorial stimulus is gone. We may read off peculiarities in an after-image, left by an object on the eye, which we failed to note in the original. We may "hark back" and take in the meaning of a sound several seconds after it has ceased. Delay for a minute, however, and the echo itself of the clock or the question is mute; present sensations have banished it beyond recall. With the feeling of the present thing there must at all times mingle the fading echo of all those other things which the previous few seconds have supplied.—JAMES *Psychology*, vol. i, ch. 15, p. 634. (H. H. & Co., 1899.)

961. ECLIPSE OF THE SUN—*Beauty of the Spectacle—Colored Flames of the Chromosphere Shine Out when Disk is Darkened—Source of the "Unnatural Light."*—Those who were at leisure to watch the coming shadow of the moon described its curved outline as distinctly visible on the plains. "A rounded ball of darkness with an orange-yellow border," one called it. Those, again, who looked down on the bright clouds below sa, the shadow was preceded by a yellow fringe, casting a bright light over the clouds and passing into orange, pink, rose-red, and dark red, in about twenty seconds. This beautiful effect was noticed by nearly all the amateur observers present, who had their attention at liberty, and was generally unseen by the professional ones, who were shut up in dark tents with photometers, or engaged otherwise than in admiring the glory of the spectacle as a spectacle merely. This strange light, forming a band of color about the shadow as seen from above, must have really covered ten miles or more in width, and have occupied a considerable fraction of a minute in passing over the heads of those below, to whom it probably constituted that lurid light on their landscape I have spoken of as so peculiar and "unnatural." It seems to be due to the colored flames round the sun, which shine out when its brighter light is extinguished. —LANGLEY *New Astronomy*, ch. 2, p. 56. (H. M. & Co.)

962. ECLIPSE, TOTAL, OF THE SUN—*Once Prolific of Superstition—Still Weird and Awe-inspiring—Man's Conscious Dependence on the Orb of Day.*—Of all astronomical phenomena, there are few which have struck the human imagination so much as total eclipses of the sun. What spectacle more strange, in fact, than that of the sudden disappearance of the day-star at noonday in the midst of a clear sky? In the days when humanity was ignorant of the natural causes of these effects, such a disappearance was considered as supernatural, and they saw in it with terror a manifestation of the divine anger. Since the natural causes have been discovered, and these phenomena are seen to answer to our calculations with the most obedient fidelity, all supernatural terror has disappeared from cultivated minds, but the grand spectacle does not the less impress the beholder.

At the hour predicted by the astronomer we see the brilliant disk of the sun cut into towards the west, and a black segment slowly advancing, eating away the solar disk until it is reduced to the form of a thin luminous crescent. At the same time daylight diminishes; from all sides a wan and sinister gleam replaces the brilliant light in which Nature rejoiced, and an infinite sadness falls upon the world. Very soon there remains nothing of the radiant star but a narrow arc of light, and hope appears disposed to wing its flight from this earth, so long illuminated by the paternal sun. Life seems still connected with the sky by an invisible thread, when suddenly the last ray of daylight dies out, and a darkness as profound as it is sudden spreads all around us, reducing the whole of Nature to astonishment and silence. The stars shine in the sky! The man who would still speak and communicate his impressions while attentively watching the phenomenon cries out with surprise; then he becomes silent, struck with stupor. The singing-bird crouches un-

der the leaf; the dog takes refuge against the legs of his master; the hen covers the chickens with her wings. Living nature is hushed—dumb with astonishment. Night has come—a night sometimes intense and profound, but oftener incomplete, strange, and extraordinary, the earth remaining vaguely illuminated by a reddish light reflected from distant regions of the atmosphere situated outside the cone of the lunar shadow which produces the eclipse. Sometimes we see shining during the eclipse all the stars of the first and second magnitude which are above the horizon, sometimes only the brightest of the planets. The temperature of the air rapidly sinks several degrees.—FLAMMARION *Popular Astronomy,* bk. ii, ch. 9, p. 194. (A.)

963. ECLIPSES CALCULATED IN FAR ANTIQUITY—*Chinese Astronomers Punished for Neglect.*—Indeed, each of the great civilizations of the ancient world seems to have had its own system of astronomy strongly marked by the peculiar character of the people among whom it was found. Several events recorded in the annals of China show that the movements of the sun and the laws of eclipses were studied in that country at a very early age. Some of these events must be entirely mythical. . . . But there is another event which, even if we place it in the same category, must be regarded as indicating a considerable amount of astronomical knowledge among the ancient Chinese. We refer to the tragic fate of Hi and Ho, astronomers royal to one of the ancient emperors of that people. It was part of the duty of these men to carefully study the heavenly movements, and give timely warning of the approach of an eclipse or other remarkable phenomenon. But, neglecting this duty, they gave themselves up to drunkenness and riotous living. In consequence, an eclipse of the sun occurred without any notice being given; the religious rites due in such a case were not performed, and China was exposed to the anger of the gods. To appease their wrath, the unworthy astronomers were seized and summarily executed by royal command. Some historians have gone so far as to fix the date of this occurrence, which is variously placed at from 2128 to 2159 before the Christian era. If this is correct, it is the earliest of which profane history has left us any record.—NEWCOMB *Popular Astronomy,* pt. i, int., p. 2. (H., 1899.)

964. ECSTASY OF HEALTH—*Animals Share with Man.*—We see that the inferior animals, when the conditions of life are favorable, are subject to periodical fits of gladness, affecting them powerfully and standing in vivid contrast to their ordinary temper. And we know what this feeling is—this periodic intense elation which even civilized man occasionally experiences when in perfect health, more especially when young. There are moments when he is mad with joy, when he cannot keep still, when his impulse is to sing and shout aloud and laugh at nothing, to run and leap and exert himself in some extravagant way. Among the heavier mammalians the feeling is manifested in loud noises, bellowings, and screamings, and in lumbering, uncouth motions—throwing up of heels, pretended panics, and ponderous mock battles.—HUDSON *Naturalist in La Plata,* ch. 19, p. 280. (C. & H., 1895.)

965. EDIFICE NOT SEEN TILL SCAFFOLDING IS REMOVED—*Admission of German Scientist—Accumulation of Details Spoils Perspective.*—There is, perhaps, some truth in the accusation advanced against many German scientific works, that they lessen the value of general views by an accumulation of detail, and do not sufficiently distinguish between those great results which form, as it were, the beacon-lights of science, and the long series of means by which they have been attained. This method of treating scientific subjects led the most illustrious of our poets [Goethe] to exclaim with impatience, "The Germans have the art of making science inaccessible." An edifice cannot produce a striking effect until the scaffolding is removed, that had of necessity been used during its erection.—HUMBOLDT *Cosmos,* vol. i, int., p. 47. (H., 1897.)

966. EDIFICE OF A HIDDEN BUILDER—*Crystal Shaped According to Law—Form Determined by Polarity of Molecules.*—I wish you to realize intellectually the process of crystalline architecture. Look then into a granite quarry, and spend a few minutes in examining the rock. It is not of perfectly uniform texture. It is rather an agglomeration of pieces, which, on examination, present curiously defined forms. You have there what mineralogists call quartz, you have felspar, you have mica. In a mineralogical cabinet, where these substances are preserved separately, you will obtain some notion of their forms. You will see there, also, specimens of beryl, topaz, emerald, tourmalin, heavy spar, fluor-spar, Iceland spar—possibly a full-formed diamond. . . . These crystals, you will observe, are put together according to law; they are not chance productions; and, if you care to examine them more minutely, you will find their architecture capable of being to some extent revealed. They often split in certain directions before a knife-edge, exposing smooth and shining surfaces, which are called planes of cleavage; and by following these planes you sometimes reach an internal form, disguised beneath the external form of the crystal. Ponder these beautiful edifices of a hidden builder. You cannot help asking yourself how they were built; and familiar as you now are with the notion of a polar force, and the ability of that force to produce structural arrangement, your inevitable answer will be that those crystals are built by the play of polar forces with

which their molecules are endowed. In virtue of these forces, atom lays itself to atom in a perfectly definite way, the final visible form of the crystal depending upon this play of its molecules.—TYNDALL *Lectures on Light*, lect. 3, p. 101. (A., 1898.)

967. EDUCATION AND MAN—*Reaction on Impressions.*—Man is an organism for reacting on impressions: his mind is there to help determine his reactions, and the purpose of his education is to make them numerous and perfect. Our education means, in short, little more than a mass of possibilities of reaction, acquired at home, at school, or in the training of affairs.—JAMES *Talks to Teachers*, ch. 6, p. 38. (H. H. & Co., 1900.)

968. EDUCATION A TEST—*Capacity to Receive Differs with Race.*—In measuring the minds of the lower races, a good test is, how far their children are able to take a civilized education. The account generally given by European teachers who have had the children of lower races in their schools is that, tho these often learn as well as the white children up to about twelve years old, they then fall off, and are left behind by the children of the ruling race. This fits with what anatomy teaches of the less development of brain in the Australian and African than in the European. It agrees also with what the history of civilization teaches, that up to a certain point savages and barbarians are like what our ancestors were and our peasants still are, but from this common level the superior intellect of the progressive races has raised their nations to heights of culture. The white man, tho now dominant over the world, must remember that intellectual progress has been by no means the monopoly of his race. At the dawn of history the leaders of culture were the brown Egyptians, and the Babylonians, whose Accadian is not connected with the language of white nations, while the yellow Chinese, whose Tatar affinity is evident in their hair and features, have been for four thousand years or more a civilized and literary nation. The dark-whites, Assyrians, Phenicians, Persians, Greeks, Romans, did not start but carried on the forward movement of culture, while since then the fair-whites, as part of the population of France, Germany, and England, have taken their share not meanly, tho latest, in the world's progress.—TYLOR *Anthropology*, ch. 3, p. 74. (A., 1899.)

969. EDUCATION BASED ON ATTENTION — *Animals and Children — Idiots and Deaf-mutes.*—"The first and most important, but also the most difficult, task at the outset of an education is to overcome gradually the inattentive dispersion of mind which shows itself wherever the organic life preponderates over the intellectual. The training of animals . . . must be in the first instance based on the awakening of attention (*cf.* Aurian Leonard, 'Essai sur l'Education des Animaux,' Lille, 1842) that is to say, we must seek to make then gradually perceive separately things which if left to themselves, would not be attended to, because they would fuse with a great sum of other sensorial stimuli to a confused total impression, of which each separate item only darkens and interferes with the rest. Similarly at first with the human child. The enormous difficulty of deaf-mute- and especially of idiot-instruction is principally due to the slow and painful manner in which we succeed in bringing out from the general confusion of perception single items with sufficient sharpness." (Waitz, "Lehrbuch der Psychologie," p. 632.)—JAMES *Psychology*, vol. i, ch. 11, p. 405. (H. H. & Co. 1899.)

970. EDUCATION DEVELOPS MENTAL ENDOWMENT—*Genius Not the Result of Training.*—Fruits and vegetables must have good nurture to reach perfection, but the gardener knowns his labor will be vain unless he starts with seed which is adapted by nature for improvement by judicious nurture; and while it is hard for us to consider the question whether the arts and accomplishments of normal men are due to anything else than training and education we feel no such difficulty when the faculties of abnormal or exceptional individuals are in question; for the restriction of the powers of idiots is clearly correlated with deficient structure, and training and education are so obviously incompetent to account for the achievements of men of genius that we are apt to believe that their natural or innate powers are different in kind from anything in our own more commonplace selves. —BROOKS *Foundations of Zoology*, lect. 10, p. 261. (C. U. P., 1899.)

971. EDUCATION OF MAN FOR SPIRITUAL LIFE—*A Creative Purpose in Nature—Material Ends Not Supreme—Complexity of Light and Light-sensations.*—This question of absorption [of light], considered with reference to its molecular mechanism, is one of the most subtle and difficult in physics. We are not yet in a condition to grapple with it, but we shall be by and by. We have, in the first place, in solar light an agent of exceeding complexity, composed of innumerable constituents, refrangible in different degrees. We find, secondly, the atoms and molecules of bodies gifted with the power of sifting solar light in the most various ways, and producing by this sifting the colors observed in Nature and art. To do this they must possess a molecular structure commensurate in complexity with that of light itself. Thirdly, we have the human eye and brain, so organized as to be able to take in and distinguish the multitude of impressions thus generated. The light, therefore, at starting is complex; to sift and select it as they do, natural bodies must be complex; while to take in the impressions thus generated, the

human eye and brain, however we may simplify our conceptions of their action, must be highly complex. Whence this triple complexity? If what are called material purposes were the only end to be served, a much simpler mechanism would be sufficient; but instead of simplicity, we have prodigality of relation and adaptation—and this apparently for the sole purpose of enabling us to see things robed in the splendors of color. Would it not seem that Nature harbored the intention of educating us for other enjoyments than those derivable from meat and drink? At all events, whatever Nature meant—and it would be mere presumption to dogmatize as to what she meant—we find ourselves here, as the upshot of her operations, endowed with capacities to enjoy not only the materially useful, but endowed with others of indefinite scope and application, which deal alone with the beautiful and the true.—TYNDALL *Lectures on Light*, lect. 1, p. 39. (A., 1898.)

972. EDUCATION, VALUE OF NATURE-STUDY IN — *Faculty of Observation Trained Early in Childhood.*—I do not hesitate to affirm that a boy or girl of, say, ten years of age may receive a certain amount of elementary biological instruction, which will be of the greatest service in the training of the child's mind, and which will assist the due appreciation of its other studies. As Sir James Paget well remarks, "The askings of children seem to indicate a natural desire after a knowledge of the purposes fulfilled in Nature"; and even where this desire is most feebly developed, the plain, interesting teaching of the grand yet simple facts of biology will tend to arouse the latent curiosity of the child, and to early awaken its sympathies with the things of living Nature. Dr. Carpenter, in his evidence before the English Public Schools Commission, lays great stress upon the importance of enabling children to begin the study of physical and natural science at an early age. He says: "The training of the observing faculties by attention to the phenomena of Nature, both in physical and in natural science, seems to me to be the natural application of time at the age of, say, from eight to twelve." Dr. Carpenter further exemplifies, by citing his own case, the value of an early training in science as tending to cultivate the observant habits more thoroughly than when the study is entered upon at a later period. The evidence of the late Sir Charles Lyell goes to support Dr. Carpenter's views in relation to the advantages of training the observant faculties in early youth; the age of nine or ten, the late distinguished geologist maintained, being that at which the powers of observation are sufficiently developed, and when, if pupils be taught natural science, "they learn a vast deal of other things in consequence."—ANDREW WILSON *Biology in Education*, p. 16. (Hum., 1888.)

973. EFFECT BEYOND APPARENT CAUSE—*Change Produced by Rise in Temperature of Two Degrees—Arctic Desolation Succeeded by Life and Movement—One Step above Brute Intelligence Gives Human Intellect.*—In part of the arctic regions at this moment there is no such thing as liquid. Matter is only known there in the solid form. The temperature may be thirty-one degrees below zero or thirty-one degrees above zero without making the slightest difference; there can be nothing there but ice, glacier, and those crystals of ice which we call snow. But suppose the temperature rose two degrees, the difference would be indescribable. While no change for sixty degrees below that point made the least difference, the almost inappreciable addition of two degrees changes the country into a world of water. The glaciers, under the new conditions, retreat into the mountains, the vesture of ice drops into the sea, a garment of greenness clothes the land. So, in the animal world, a very small rise beyond the animal maximum may open the door for a revolution.—DRUMMOND *Ascent of Man*, ch. 5, p. 186. (J. P., 1900.)

974. ——— ——— *General Tide-movement Increased by Local Conditions.*—The moon raises the surface of the sea at the equator by fifty centimeters [about 19.7 inches], and, the action of the sun being added, the elevation reaches 74 centimeters [29.1 inches]. The height decreases up to the poles, where the amplitude of the oscillations is reduced to zero, and there is no tide, even when the sea is not frozen.

The amount by which the surface of the sea is raised and lowered successively is, in general, very much greater than what we have stated, assuming that this surface takes at each instant the figure of equilibrium which agrees with the magnitude and direction of the attractions of the sun and moon. We have seen that the greatest difference of level which can exist, on this hypothesis, between high water and the following low water is only 2.43 feet at the equator, if the sun and moon are at their mean distances. Now, there exist certain localities where the same difference exceeds thirty-two feet in the vertical direction.—FLAMMARION *Popular Astronomy*, bk. ii, ch. 7, p. 166. (A.)

975. ——— ——— *Tides Rise Higher than Attraction of Sun and Moon Would Draw Them—Momentum Outlives Incitement.*—The waters of the sea, contained in a space limited on both sides by the continents, oscillate in this space, which forms a sort of vessel of small depth relatively to its surface: these oscillations are kept up by the disturbing actions of the moon and sun, of which the intensity and the direction change every instant. When, in consequence of these actions, the surface of the sea is forced to rise at a certain side of the basin which contains it, the water is carried to

that side, and the velocity with which the change of place is effected is the reason that it does not stop when the surface has attained equilibrium, but continues to move in the same direction until the velocity is completely destroyed by the action of gravity, and by the friction against the bottom; so that the oscillatory movement in the vertical direction thus becomes, on the borders of the sea, of much greater proportions than if the sea were placed at each instant in equilibrium under the action of the forces which are applied to it. We understand from this, not only why the sea is raised and lowered much more than seems to be caused by the actions of the moon and sun, but, further, why . . . the waters which have risen by these actions . . . continue still to rise for some time [afterwards] in virtue of their acquired velocity. —FLAMMARION *Popular Astronomy*, bk. ii, ch. 8, p. 167. (A.)

976. ——— *Unlocking of Energy —Spark Produces Conflagration.* — To account for the propagation of fire was one of the difficulties of the last century. A spark was found sufficient to initiate a conflagration. The effect here seemed beyond all proportion greater than the cause, and herein lay the philosophical difficulty. By a striking analogy Boscovich made clear to his own mind how small causes produce vast effects. He pictures a high mountain rising out of the sea, with sides so steep that blocks of stone are just able to rest upon them without rolling down. He supposes such blocks, diminishing gradually in size, to be strewn over the mountain—large below, moderate at the middle height, and dwindling to sand-grains at the top. A small bird touches with its foot a grain on the summit; it moves, sets the next large grains in motion, these again let loose the pebbles, these the larger stones, these the blocks; until finally the whole mountainside rolls violently into the sea, there producing mighty waves. Here the foot of the little bird unlocked the energy, the rest of the work being done by gravitation. This he regarded as an image whereby the propagation of fire might be rendered intelligible. The spark acts like the foot of the bird; it starts a process which is continued and vastly augmented by the molecular forces of the fuel. The force which moves a train is potential in the boiler before the steam is turned on. The hand of the engineer releases a detent and permits the potential to become actual. It, however, like the bird of Boscovich, only liberates a preexisting power. The action of the nerves in unlocking the power of the muscles also falls in admirably with the conception of Boscovich here described. —TYNDALL *Heat a Mode of Motion*, lect. 3, p. 64. (A., 1900.)

977. EFFECT, MIGHTY, FROM TRIVIAL CAUSE - *Time Multiplies Results—Natural Causes Extended through Limitless Past.*—Many geologists had previously imagined that the highest chains of mountains which rise on the surface of the earth could owe their origin only to enormous revolutions transforming a great part of the earth's surface, especially to colossal volcanic eruptions. Such chains of mountains as those of the Alps or the Cordilleras were believed to have arisen direct from the fiery fluid of the interior of the earth, through an enormous chasm in the broken crust. Lyell, on the other hand, showed that we can explain the formation of such enormous chains of mountains quite naturally by the same slow and imperceptible risings and depressions of the earth's surface which are still continually taking place, and the causes of which are by no means miraculous. Altho these depressions and risings may perhaps amount only to a few inches, or at most a few feet, in the course of a century, still in the course of some millions of years they are perfectly sufficient to raise up the highest chains of mountains, without the aid of mysterious and incomprehensible revolutions. In like manner, the meteorological action of the atmosphere, the influence of rain and snow, and, lastly, the breakers on the coasts, which by themselves seem to produce an insignificant effect, must cause the greatest changes if we only allow sufficiently long periods for their action. The multiplication of the smallest causes produces the greatest effects. Drops of water produce a cavity in a rock.—HAECKEL *History of Creation*, vol. i, ch. 6, p. 130. (K. P. & Co., 1899.)

978. EFFECT OF FIRE ON ANIMALS —*Birds Dashing Themselves against Lighthouse.*—The fires which travelers make for their protection actually serve to attract the beasts of prey, but the confusion and fear caused by the bright glare make it safe for the traveler to lie down and sleep in the light. Mammals do not lose their heads altogether, because they are walking on firm ground where muscular exertion and an exercise of judgment are necessary at every step; whereas birds floating buoyantly and with little effort through the air are quickly bewildered. Incredible numbers of migratory birds kill themselves by dashing against the windows of lighthouses; on bright moonlight nights the voyagers are comparatively safe; but during dark cloudy weather the slaughter is very great; over six hundred birds were killed by striking a lighthouse in Central America in a single night. On insects the effect is the same as on the higher animals: on the ground they are attracted by the light, but keep, like wolves and tigers, at a safe distance from it; when rushing through the air and unable to keep their eyes from it they fly into it, or else revolve about it, until, coming too close, their wings are singed.—HUDSON *Naturalist in La Plata*, ch. 13, p. 176. (C. & H., 1895.)

979. EFFECT OF HEAT AND COLD RESISTLESS—*Lead Crawls Down Cathedral Roof.*—A very curious effect of expansion was observed, and explained, some years ago, by the late Canon Moseley. The choir of Bristol Cathedral was covered with sheet lead, the length of the covering being 60 feet, and its depth 19 feet 4 inches. It had been laid on in the year 1851, and two years afterwards it had moved bodily down through a distance of eighteen inches. The descent had been continually going on from the time the lead had been laid down, and an attempt made to stop it by driving nails into the rafters had failed; for the force of descent was sufficient to draw out the nails. The roof was not a steep one, and the lead would have rested on it forever, without sliding. What, then, was the cause of the descent? Simply this: The lead was exposed to the varying temperatures of day and night. During the day the heat imparted to it caused it to expand. Had it lain upon a horizontal surface, it would have expanded equally all round; but as it lay upon an inclined surface, it expanded more freely downwards than upwards. When, on the contrary, the lead contracted at night, its upper edge was drawn more easily downwards than its lower edge upwards. Its motion was therefore that of a common earthworm; it pushed its lower edge forward during the day, and drew its upper edge after it during the night, and thus by degrees it crawled through a space of eighteen inches in two years. Every minor change of temperature during the day and during the night contributed also to the result; indeed Canon Moseley afterwards found the main effect to be due to these quicker alternations of temperature.—TYNDALL *Heat a Mode of Motion*, lect. 4, p. 95. (A., 1900.)

980. EFFECT OF HUMAN INFANCY AND CHILDHOOD—*Animal Affection for Offspring Perishes and Is Forgotten.*—Till the brain arrived, everything was too brief, too rapid for ethical achievements; animals were in a hurry to be born, children thirsted to be free. There was no helplessness to pity, no pain to relieve, no quiet hours, no watching; to the mother, no moment of suspense—the most educative moment of all—when the spark of life in her little one burned low. Parents could be [of] no use to their offspring physically, and the offspring could be [of] no use to their parents psychically. The young required no infancy; the old acquired no sympathy. Even among the other mammalia or the birds the mother's chance was small. There, infancy extends to a few days or weeks, yet is but an incident in a life preoccupied with sterner tasks. A lioness will bleed for her cub to-day, and in to-morrow's struggle for life contend with it to the death. A sheep knows its lamb only while it is a lamb. The affection in these cases, fierce enough while it lasts, is soon forgotten, and the traces it left in the brain are obliterated before they have furrowed into habit.—DRUMMOND *Ascent of Man*, ch. 8, p. 287. (J. P., 1900.)

981. EGG PRODUCING ALL MATERIAL FOR THE CHICKEN—The egg itself contains all the materials of a complete animal. Bones, muscles, viscera, brain, nerves, and feathers of the chicken—all are produced from the egg, nothing being added, and little or nothing taken away.

I should, however, add that in eating an egg we do not get quite so much of it as the chicken does. Liebig found by analysis that in the white and the yolk there is a deficiency of mineral matter for supplying the bones of the chick, and that this deficiency is supplied by some of the shell being dissolved by the phosphoric acid which is formed inside the egg by the combination of the oxygen of the air (which passes through the shell) with the phosphorus contained in the soft matter of the egg.

By comparing the shell of a hen's egg after the chicken is hatched from it with that of a freshly laid egg, the difference of thickness may be easily seen.—WILLIAMS *Chemistry of Cookery*, ch. 3, p. 19. (A., 1900.)

982. EGOISM, UNMITIGATED, OF ANCIENT GEOLOGIC WORLD—*"Dragons of the Prime"—Slow Attainment of Better Things.*—What spectacle could be more dreary than that of the Jurassic period, with its lords of creation, the oviparous dinosaurs, crawling or bounding over the land, splashing amid the mighty waters, whizzing bat-like through the air, horrible brutes innumerable, with bulky bodies and tiny brains, clumsy, coarse in fiber, and cold-blooded.

"Dragons of the prime,
That tare each other in their slime."

The remnants of that far-off dismal age have been left behind in great abundance, and from them we can easily reconstruct the loathsome picture of a world of dominating egoism. Nearly nine-tenths of our planet's past life-history, measured in duration, had passed away without achieving any higher result than this—a fact which for impatient reformers may have in it some crums of consolation.—FISKE *Through Nature to God*, pt. ii, ch. 11, p. 122. (H. M. & Co., 1900.)

983. EGYPT, SEEDS AND PLANTS OF—*Superstition Ministers to Science.*—The evidence derived from the Egyptian monuments was not confined to the animal kingdom; the fruits, seeds, and other portions of twenty different plants, were faithfully preserved in the same manner; and among these the common wheat was procured by Delille, from closed vessels in the sepulchers of the kings, the grains of which retained not only their form, but even their color; so effectual has proved the process of embalming with bitumen in a dry and equable climate.

No difference could be detected between this wheat and that which now grows in the East and elsewhere; and in regard to the barley, I am informed by Mr. Brown, the celebrated botanist, that its identity with the grain of our own times can be tested by the closest comparison. On examining, for example, one of the seeds from Mr. Sam's Egyptian collection in the British Museum, it is found that "the structure of the husks, or that part of the flower which is persistent, agrees precisely with the barley of the present day, in having one perfect flower and the filiform rudiments of a second." Some naturalists believe that the perfect identification of the ancient Egyptian cerealia with the varieties now cultivated has been carried still further by sowing the seeds taken out of the catacombs, and raising plants from them; but we want more evidence of this fact. Certain it is, that when the experiment was recently made in the botanic garden at Kew, with 100 seeds of wheat, barley, and lentils, from the Egyptian collection before mentioned of the British Museum, not one of them would germinate.—LYELL *Principles of Geology*, bk. iii, ch. 34, p. 587. (A., 1854.)

984. ——— ——— *Travelers Imposed Upon—Evidence Not Carefully Sifted.*—I by no means wish to express an opinion that seeds cannot retain their vitality after an entombment of 3,000 years; but one of my botanical friends who entertained a philosophical doubt on this subject, being desirous of ascertaining the truth of three or four alleged instances of the germination of "mummy wheat," discovered, on communicating with several Egyptian travelers, that they had produced the grains in question, not directly from the catacombs, but from the Arabs, who are always ready to supply strangers with an article now very frequently in demand. The presence of an occasional grain of Indian corn or maize in several of the parcels of grain shown to my friend as coming from the catacombs confirmed his skepticism.—LYELL *Principles of Geology*, bk. iii, ch. 34, p. 587. (A., 1854.)

985. ELECTRICITY A FORM OF ENERGY—*Electric "Fluid" and "Current" Misnomers.*—Electricity is not a fluid, or any form of material substance, but a form of energy. Energy is expressed in different ways, and, while as energy it is one and the same, we call it by different names—as heat energy, chemical energy, electrical energy, and so on. They will all do work, and in that respect are alike. One difficulty in explaining electrical phenomena is the nomenclature that the science is loaded down with. All the old names were adopted when electricity was regarded as a fluid, hence the word "current." It is spoken of as "flowing" when it does not flow any more than light flows.—ELISHA GRAY *Nature's Miracles*, vol. iii, ch. 5, p. 41. (F. H. & H., 1900.)

986. ELECTRICITY A RECENT SCIENCE—Electricity as a well-developed science is not old. Those of us who have lived fifty years have seen nearly all its development so far as it has been applied to useful purposes, and those who have lived over twenty-five years have seen the major portion of its development.—ELISHA GRAY *Nature's Miracles*, vol. iii, ch. 2, p. 6. (F. H. & H., 1900.)

987. ELECTRICITY A RESULT OF EVERY CHANGE—*Perhaps a Mode of Molecular Motion.*—More recently it has been discovered that friction is by no means the only source of electricity, and it seems probable that no change, either chemical or physical, takes place in Nature without some manifestation of this agent. It was at first supposed that there were several kinds of electricity, which were named thermo-electricity, magneto-electricity, voltaic electricity, and animal electricity, according to the nature of the process in which the electrical action was developed; but it is now universally conceded that all are only different manifestations of the same agent, and most investigators believe that electricity will in time be shown to be a form of molecular motion analogous to that which produces the phenomena of light and heat, altho it has not as yet been found possible to frame a comprehensive and intelligible theory based upon this hypothesis.—COOKE *Religion and Chemistry*, ch. 2, p. 59. (A., 1897.)

988. ELECTRICITY, EVOLUTION OF, FROM STEAM—*Theory of the Thunder-cloud.*—If the vaporization of the water were shown to be the source of the electricity, Professor Henry thought the phenomena might be readily explained by the beautiful theory of Becquerel, in regard to the production of the great intensity of the electricity in the thunder-cloud. According to this theory, each particle of the vapor carries up with it into the atmosphere the free electricity which it receives at the moment of the change of state: this being diffused through the whole capacity of the air is of very feeble intensity, altho of great quantity; but the condensation of the vapor in a cloud affords a continuous conductor, and consequently the electricity of all the particles of the interior, according to the well-known principles of distribution, rushes to the surface of the cloud, and hence the great intensity of the lightning. Agreeably with this hypothesis, the insulated conductor, placed in the steam, would act not only as a collector, but also as a condenser of the free but feeble electricity of the vapor.—HENRY *Scientific Writings*, p. 190. (Sm. Inst., 1840.)

989. ELECTRICITY GENERATED BY VOLCANIC ERUPTION—*Elemental Forces Joined.*—It is well known that when high-pressure steam is allowed to escape through an orifice, electricity is abundantly gener-

ated by the friction, and Sir William Armstrong's hydro-electric machine is constructed on this principle. Every volcano in violent eruption is a very efficient hydro-electric machine, and the up-rushing column is in a condition of intense electrical excitation. This result is probably aided by the friction of the solid particles as they are propelled upwards and fall back into the crater. The restoration of the condition of electrical stability between this column and the surrounding atmosphere is attended with the production of frequent lightning-flashes and thunderclaps, the sound of the latter being usually, however, drowned in the still louder roar of the up-rushing steam-column.—JUDD *Volcanoes*, ch. 2, p. 29. (A., 1899.)

990. ELECTRICITY GIVES NEW PRODUCTS—*Carborundum.*—The production of electricity in such enormous quantities as are generated at Niagara Falls has led to many discoveries and will lead to many more. Products that at one time existed only in the chemical laboratory for experimental purposes have been so cheapened by utilizing electrical energy in their manufacture as to bring them into the play of every-day life. Still other products have only been discovered since the advent of heavy electrical currents. A substance called carborundum, which was discovered as late as 1891, has now become the basis of an industry of no small importance. It is a substance not unlike a diamond in hardness, and not very unlike it in its composition. The chief use to which it is put is for grinding metals and all sorts of abrasive work. It is manufactured into wheels, in structure like the emery-wheel, and serves the same purpose. It is much more expensive than the emery-wheel, but it is claimed that it will do enough more and better work to make it fully as economical.—ELISHA GRAY *Nature's Miracles*, vol. iii, ch. 25, p. 209. (F. H. & H., 1900.)

991. ELECTRICITY IN ANIMALS—*Battery of the Electric Ray—Scientific Structure in Living Organism.*—The electric ray, or torpedo, has been provided with a battery closely resembling, but greatly exceeding in the beauty and compactness of its structure, the batteries whereby man has now learned to make the laws of electricity subservient to his will. There are no less than 940 hexagonal columns in this battery like those of a bee's comb, and each of these is subdivided by a series of horizontal plates, which appear to be analogous to the plates of the voltaic pile. The whole is supplied with an enormous amount of nervous matter, four great branches of which are as large as the animal's spinal cord, and these spread out in a multitude of threadlike filaments round the prismatic columns, and finally pass into all the cells. This, again, seems to suggest an analogy with the arrangement by which an electric current, passing through a coil and round a magnet, is used to intensify the magnetic force. A complete knowledge of all the mysteries which have been gradually unfolded from the days of Galvani to those of Faraday, and of many others which are still inscrutable to us, is exhibited in this structure.—ARGYLL *Reign of Law*, ch. 2, p. 61. (Burt.)

992. ELECTRICITY IN MEDICINE—*Electric Lamps for Pathological Investigation—Dentistry Aided—Submarine Boats.*—Small incandescent lamps are now used for examinations of the larynx and in dentistry, and a lamp has even been introduced into the stomach by which the condition of that organ can be examined. For this last purpose numerous ingenious arrangements have to be made to prevent possible injury, and by means of prisms at the bends of the tube the operator can inspect the interior of the organ under a brilliant light. Other internal organs have been explored in a similar manner, and many new applications in this direction will no doubt be made. In illuminating submarine boats and exploring the interiors of sunken vessels it does what could hardly be effected by any other means. —WALLACE *The Wonderful Century*, ch. 4, p. 29. (D. M. & Co., 1899.)

993. ELEMENTS, CHEMICAL, MAY BE COMPOUNDS—*Perhaps Resolvable on the Sun and Stars—The "Dissociation Theory."*—Professor Lockyer's view [of the separation or dissociation of chemical elements on the sun] has the argument from continuity in its favor. It only asks us to believe that processes which we know to take place on the earth under certain conditions, are carried further in the sun, where the same conditions are, it may be presumed, vastly exalted. We find that the bodies we call "compound" split asunder at fixed degrees of heat within the range of our resources. Why should we hesitate to admit that the bodies we call "simple" do likewise at degrees of heat without the range of our resources? The term "element" simply expresses terrestrial incapability of reduction. That, in celestial laboratories, the means and their effect here absent should be present, would be an inference challenging, in itself, no expression of incredulity.

Yet it is, in point of fact, a revolutionary one, and its acceptance will involve the reconstruction of more than one fair edifice of scientific thought.—CLERKE *History of Astronomy*, pt. ii, ch. 4, p. 259. (Bl., 1893.)

994. ELEMENTS IN OTHER SUNS—*Spectrum of Sirius.*—The spectrum of this brilliant white star [Sirius] is very intense; but seen at its small altitude above the horizon, even when it is most favorably situated, the observation of the finest lines is rendered very difficult by the motions of the atmosphere. Three, if not four, elementary bodies show spectra in which the lines coincide

with those of Sirius; these are sodium, magnesium, hydrogen, and probably iron. The lines of hydrogen are abnormally strong compared to those which exist in the solar spectrum.—FLAMMARION *Popular Astronomy,* bk. vi, ch. 6, p. 609. (A.)

995. ELEMENTS OF EARTHLY SUBSTANCE FOUND WIDELY DIFFUSED IN SPACE—*Still Surrounded by the Unknown.*—We cannot, indeed, say that we have explained all spectra; many fixed stars exhibit peculiarly banded spectra, probably belonging to gases whose molecules have not been completely resolved into their atoms by the high temperature. In the spectrum of the sun, also, are many lines which we cannot identify with those of terrestrial elements. It is possible that they may be due to substances unknown to us; it is also possible that they are produced by the excessively high temperature of the sun, far transcending anything we can produce. But this is certain, that the known terrestrial substances are widely diffused in space.—HELMHOLTZ *Popular Lectures,* lect. 4, p. 156. (L. G. & Co., 1898.)

996. ELEMENTS OF TERROR ACCUMULATED—*Lightnings Attend Volcanic Eruption.*—Another striking phenomenon which was exhibited in the great eruption of Vesuvius in 1872 was the vivid display of lightning accompanied by thunder. The uprushing current of steam and rock-fragments forms a vertical column, but as the steam condenses it spreads out into a great horizontal cloud which is seen to be made up of the great globes of vapor emitted at successive explosions. When there is little or no wind the vertical column with a horizontal cloud above it bears a striking resemblance to the stone-pine trees which form so conspicuous a feature in every Neapolitan landscape. Around this column of vapor the most vivid lightning constantly plays and adds not a little to the grand and awful character of the spectacle of a volcanic eruption, especially when it is viewed by night.—JUDD *Volcanoes,* ch. 2, p. 28. (A., 1899.)

997. ELEVATION OF BED OF NILE—*Fertility Encroaching upon the Desert.*—The bed of the Nile always keeps pace with the general elevation of the soil, and the banks of this river, like those of the Mississippi and its tributaries, are much higher than the flat land at a distance, so that they are seldom covered during the highest inundations. In consequence of the gradual rise of the river's bed, the annual flood is constantly spreading over a wider area, and the alluvial soil encroaches on the desert, covering, to the depth of six or seven feet, the base of statues and temples which the waters never reached 3,000 years ago. Altho the sands of the Libyan Desert have in some places been drifted into the valley of the Nile, yet these aggressions, says Wilkinson, are far more than counterbalanced by the fertilizing effect of the water which now reaches farther inland towards the desert, so that the number of square miles of arable soil is greater at present than at any previous period.—LYELL *Principles of Geology,* bk. ii, ch. 17, p. 262. (A., 1854.)

998. ELEVATION, SLOW, OF EARTH'S CRUST—*Streams Cut Down as Fast as Surface Is Lifted.*—Yet, strange to say, none of these earth-movements succeeded in deflecting the main drainage of the [Grand Cañon] district. The Colorado and its chief affluents continued to flow in the courses they had attained at the final disappearance of the great lake. It is clear, therefore, that the bending and dislocation of the strata must have proceeded very slowly, for the rivers were able to cut their way across both flexures and faults as fast as these showed at the surface.—GEIKIE *Earth Sculpture,* ch. 3, p. 57. (G. P. P., 1898.)

999. EMBLEM OF DIVINE FULNESS—*Power of the Sun's Heat—Lavish Beneficence.*—Working out the results of the Mount Whitney expedition, he [Langley] was led to conclude atmospheric absorption to be fully twice as effective as had hitherto been supposed. Scarcely sixty per cent., in fact, of those solar radiations which strike perpendicularly through a seemingly translucent sky attain the sea-level. The rest are reflected, dispersed, or absorbed. This discovery involved a large addition to the original supply so mercilessly cut down in transmission. . . . The sun's heat reaching the outskirts of our atmosphere is capable of doing without cessation the work of an engine of three horse-power for each square yard of the earth's surface. Thus, modern inquiries, tho they give no signs of agreement, within any tolerable limits of error, as to the probable temperature of the sun, tend, with growing certainty, to render more and more evident the vastness of the thermal stores contained in the great central reservoir of our system.—CLERKE *History of Astronomy,* pt. ii, ch. 5, p. 279. (Bl., 1893.)

1000. EMBRYO SHAPED BY VIEWLESS ARTIST—The student of Nature wonders the more and is astonished the less, the more conversant he becomes with her operations; but of all the perennial miracles she offers to his inspection, perhaps the most worthy of admiration is the development of a plant or of an animal from its embryo. Examine the recently laid egg of some common animal, such as a salamander or a newt. It is a minute spheroid in which the best microscope will reveal nothing but a structureless sac, enclosing a glairy fluid, holding granules in suspension. But strange possibilities lie dormant in that semi-fluid globule. Let a moderate supply of warmth reach its watery cradle, and the plastic matter undergoes changes so rapid and yet so steady and purpose-like in their succession, that one can only compare them to those operated by a skilled modeler upon a form-

less lump of clay. As with an invisible trowel, the mass is divided and subdivided into smaller and smaller portions, until it is reduced to an aggregation of granules not too large to build withal the finest fabrics of the nascent organism. And then it is as if a delicate finger traced out the line to be occupied by the spinal column, and molded the contour of the body; pinching up the head at one end, the tail at the other, and fashioning flank and limb into due salamandrine proportions, in so artistic a way that, after watching the process hour by hour, one is almost involuntarily possessed by the notion that some more subtle aid to vision than an achromatic would show the hidden artist, with his plan before him, striving with skilful manipulation to perfect his work.—HUXLEY *Lay Sermons*, serm. 12, p. 260. (G. P. P., 1899.)

1001. EMOTION AND PASSION, DEVELOPMENT DEPENDENT ON—*Mission of Pain.*—But human life and human development, in the wider and higher meaning of those words, would be infinitely less rich and interesting were it not for so varied and mighty emotions and passions, with all the part they have played in history, art, and religion. In a grander significance than biology or comparative psychology can properly recognize, the effective forces have been "serviceable" to the race. If the final purpose of life were merely to conserve and propagate itself, there would seem to be as little use for so many and strong emotions as for so much and such qualitatively varied pain. At this point, psychology is compelled to hand over to ethical philosophy rather than to biology the larger problems started by the study of human feeling. Here we find, on one side, the conclusion expressed by Matthew Arnold, as follows:

"Fulness of life and power of feeling, ye
Are for the happy, for the souls at ease,
Who dwell on a firm basis of content."

But, on the other side, the rational faith of Browning:

"Put pain from out the world, what room were left
For thanks to God, for love to man?"

—LADD *Psychology*, ch. 23, p. 558. (S., 1899.)

1002. EMOTION, FIELD FOR STUDY OF—*Best Observed among the Common People.*—In order to analyze the involuntary movements occasioned by pain, joy, fear, anger, and other emotions, Leonardo da Vinci counseled young artists to mingle with the common people, where the various stirrings of the heart are naturally imprinted in change of countenance and of gesture.—KAAT *Leonardo da Vinci als Naturforscher.* (Translated for *Scientific Side-Lights.*)

1003 EMULATION HAS A NOBLE SIDE—*Rivalry Leads to Magnanimity.*—The feeling of rivalry lies at the very basis of our being, all social improvement being largely due to it. There is a noble and generous kind of rivalry, as well as a spiteful and greedy kind; and the noble and generous form is particularly common in childhood. All games owe the zest which they bring with them to the fact that they are rooted in the emulous passion, yet they are the chief means of training in fairness and magnanimity.—JAMES *Talks to Teachers*, ch. 7, p. 52. (H. H. & Co., 1900.)

1004. ENDOWMENT CONDITIONS EXPERIENCE—*Child Learning to Walk—Chimpanzee—Dancing Dog.*—It must be clear to any one who compares the erect progression of a child who has just learned to walk with that of a "dancing dog," or even of a chimpanzee, that while experience makes its acquirement possible in each case, only an organism which is at the same time structurally adapted for erect progression, and possessed of a special coordinating faculty, can turn such experience to full account.—CARPENTER *Mental Physiology*, bk. ii, ch. 11, p. 474. (A., 1900.)

1005. ENDS AND MEANS IN SCIENCE—*Each Achievement a Step to New Discovery.*—The growth of science is organic. That which to-day is an end becomes to-morrow a means to a remoter end. Every new discovery in science is immediately made the basis of other discoveries, or of new methods of investigation. Thus about fifty years ago, Oersted, of Copenhagen, discovered the deflection of a magnetic needle by an electric current; and about the same time Thomas Seebeck, of Berlin, discovered thermo-electricity. These great discoveries were soon afterwards turned to account by Nobili and Melloni in the construction of an instrument which has vastly augmented our knowledge of radiant heat.—TYNDALL *Lectures on Light*, lect. 5, p. 179. (A., 1898.)

1006. ——— ——— *Magnetic Attraction vs. Human—Man Changes Means to Reach Determined End.*—If some iron filings be sprinkled on a table and a magnet brought near them, they will fly through the air for a certain distance and stick to its surface. A savage seeing the phenomenon explains it as the result of an attraction or love between the magnet and the filings. But let a card cover the poles of the magnet, and the filings will press forever against its surface without its ever occurring to them to pass around its sides and thus come into more direct contact with the object of their love. . . . If now we pass from such actions as these to those of living things, we notice a striking difference. Romeo wants Juliet as the filings want the magnet: and if no obstacles intervene he moves towards her by as straight a line as they. But Romeo and Juliet, if a wall be built between them, do not remain idiotically pressing their faces against its opposite sides like the magnet and the filings with the card. Romeo soon finds a circuitous way, by

scaling the wall or otherwise, of touching Juliet's lips directly. With the filings the path is fixed; whether it reaches the end depends on accidents. With the lover it is the end which is fixed, the path may be modified indefinitely.—JAMES *Psychology*, vol. i, ch. 1, p. 6. (H. H. & Co., 1899.)

1007. ENDURANCE A GROWTH—*Ability to Sustain Pressure Gradually Acquired—Deep-sea Organisms Perish from Lack of Pressure at Surface.*—It is but reasonable to suppose that the ability to sustain this enormous pressure [of the ocean depths] can only be acquired by animals after generations of gradual migrations from shallow waters. Those forms that are brought up by the dredge from the depths of the ocean are usually killed and distorted by the enormous and rapid diminution of pressure in their journey to the surface, and it is extremely probable that shallow-water forms would be similarly killed and crushed out of shape were they suddenly plunged into very deep water.—HICKSON *Fauna of the Deep Sea*, ch. 2, p. 21. (A., 1894.)

1008. ENDURANCE OF HIGH TEMPERATURES BY HUMAN BODY—*Heat Converted into Work.*—You would certainly suffer if you lay down upon a plate of metal in a Turkish bath; but you do not suffer when you lie down on a bench of wood. By preserving the body from contact with good conductors, very high temperatures may be endured. Eggs may be boiled, and beefsteaks cooked, by the heat of an apartment, in which the bodies of living men sustain no injury. The philosophy of this last experiment is worthy of a moment's consideration. With it the names of Blagden and Chantrey are associated, those eminent men having exposed themselves in ovens to temperatures considerably higher than that of boiling water. Let us compare the condition of the two living human beings with that of two marble statues, placed in the same oven. The statues become gradually hotter, until finally they assume the temperature of the air of the oven; the two men, under the same circumstances, do not similarly rise in temperature. If they did, the tissues of the body would be infallibly destroyed, the temperature endured being more than sufficient to stew the muscles in their own liquids. Here the excess of heat, instead of being applied to increase the temperature of the body, is applied to change its aggregation; the heat prepares the perspiration, forces it through the pores, and vaporizes it. Heat is thus consumed in work. This is the waste-pipe, if I may use the term, through which the excess overflows. Some people have professed to see, in this power of the living body to resist a high temperature, a conservative action peculiar to the vital force. No doubt all the actions of the animal organism are connected with what we call its vitality; but the action here referred to is the same in kind as the melting of ice or the vaporization of water. It consists simply in the diversion of heat from the purposes of temperature to the performance of work.—TYNDALL *Heat a Mode of Motion*, lect. 9, p. 242. (A., 1900.)

1009. ENEMIES ESCAPED BY MIGRATION—*Plants Thrive in New Soil.*—Every horticulturist knows that apples grown in a new country, that is suited to them, are healthy and fair; but, sooner or later, the scab, and codling-moth, and bitter rot, and bark-louse arrive, each to begin its particular mode of attack. Peach-trees in new places, remote from others, are often easily grown and free from dangers; but soon will arrive the yellows, borers, leaf-curl rot, and other enemies. For a few years plums may be grown, in certain new localities, without danger from curculio, or rot, or shot-hole fungus. It has long been known that the nicest way to grow a few cabbages, radishes, squashes, cucumbers, or potatoes, is to plant a few here and there in good soil, at considerable distances from where any have heretofore been grown. For a time enemies are not likely to find them. —BEAL *Seed Dispersal*, ch. 9, p. 85. (G. & Co., 1898.)

1010. ENERGY AMID INHIBITIONS THE HIGHEST MENTAL TYPE—Not to proceed immediately to extremities, to be still able to act energetically under an array of inhibitions—that indeed is rare and difficult. Cavour, when urged to proclaim martial law in 1859, refused to do so, saying: "Any one can govern in that way. I will be constitutional." Your parliamentary rulers, your Lincoln, your Gladstone, are the strongest type of man, because they accomplish results under the most intricate possible conditions. We think of Napoleon Bonaparte as a colossal monster of willpower, and truly enough he was so. But, from the point of view of the psychological machinery, it would be hard to say whether he or Gladstone was the larger volitional quantity; for Napoleon disregarded all the usual inhibitions, and Gladstone, passionate as he was, scrupulously considered them in his statesmanship.—JAMES *Talks to Teachers*, ch. 15, p. 180. (H. H. & Co., 1900.)

1011. ENERGY AND FORCE DISCRIMINATED—*Work the Measure of Energy.* —To the ordinary mind energy and force represent the same thing. And it has not been many years, comparatively, since even scientific men used the words synonymously. Modern chemistry and modern physics make a distinction, and define the two words differently.

"Force" is defined as the cause of motion, or the generator of momentum, while "energy" is expressed in the motion itself, in its power to do work. Force refers to the causes, while energy refers to work or the capacity to do work. The distinction is one that is difficult to make plain. Strictly de-

fined, force is any agency that can cause a motion, arrest a motion, or change the direction of a motion, while energy is motion or the capacity to become motion, and this carries with it the idea of work.—ELISHA GRAY *Nature's Miracles,* vol. ii, ch. 1, p. 1. (F. H. & H., 1900.)

1012. ENERGY DERIVED FROM SUN —*All Work Result of Heat.*—This great principle [the conservation of energy] enables us to realize the absolute interdependence of all the forces of Nature. It teaches us that there is no origination of force upon the earth, but that all energy either now comes to us from the sun, or was originated in the sun before our earth separated from it; and we are thus led to the conclusion that all work, all motion, every manifestation of power we see around us, are alike the effects of heat or of other radiant forces allied to it.—WALLACE *The Wonderful Century,* ch. vii, p. 53. (D. M. & Co., 1899.)

1013. ENERGY, ELECTRICAL, BATTERY A STORE OF—*Resemblance of Electricity to Fire—Force Stored in Coal or Zinc—Production of Power Costs Destruction of Material (as Such).*—Again, it may be said, with perfect truth, that every voltaic battery is a store of electrical energy. In a voltaic battery some metal is employed, generally zinc, which, when the battery is working, is acted on chemically by an acid. The effect of this chemical action is that the atoms of the metal combine with the oxygen of the acid; and by the act of combination an electric current is generated. . . . In the case of coal, we have carbon and hydrogen existing apart from oxygen, with a chemical force tending to make them combine, under suitable conditions. We set up these conditions when we light a fire: the chemical force then comes into action; the carbon and hydrogen rush to meet the oxygen; and in the clash of atoms heat is developed. Similarly, in the voltaic battery, we have zinc existing apart from oxygen, with a chemical force tending to pull them together. We bring this force into action when we arrange the cells of our battery and make the necessary connections; the atoms of zinc and oxygen then clash together, and, by the energy of their collision, an electric current is generated. Thus it is clear that, exactly in the same sense in which heat energy is said to be stored in a lump of coal, it may also be said that electrical energy is stored in the zinc plates of a battery. It is worth observing, too, that both cases furnish a striking illustration of a universal law of Nature. We cannot use our store of energy, and keep our store, at the same time. We cannot get heat from coal except by a process in which the coal is burned, and ceases to exist as coal. And so, too, we cannot get an electric current from our zinc plates except by a process in which the zinc is gradually consumed, and ceases to exist as zinc.—MOLLOY *The Storing of Electrical Energy,* p. 48. (Hum., 1889.)

1014. ENERGY, MANUFACTURE OF, IMPOSSIBLE—*Fallacy of Perpetual Motion.*—One result of the due apprehension of our personal helplessness will be that we shall no longer waste our time over the impossible task of manufacturing energy for ourselves. Our science will bring to an abrupt end the long series of severe experiments in which we have indulged in the hope of finding a perpetual motion. And having decided upon this once for all, our first step in seeking a more satisfactory state of things must be to find a new source of energy. Following Nature, only one course is open to us. We must refer to environment. The natural life owes all to environment, so must the spiritual. Now the environment of the spiritual life is God. As Nature therefore forms the complement of the natural life, God is the complement of the spiritual.—DRUMMOND *Natural Law in the Spiritual World,* essay 7, p. 244. (H. Al.)

1015. ENERGY OF POSITION—*Water at High Level Able To Do Work—Crossbow Bent—Watch Wound Up.*—Let us suppose there are two mills, one with a large pond of water near it and at a high level, while the other has also a pond, but at a lower level than itself. We need hardly ask which of the two is likely to work—clearly the one with the pond at a low level can derive from it no advantage whatever, while the other may use the high-level pond, or head of water, as this is sometimes called, to drive its wheel and do its work. There is, thus, a great deal of work to be got out of water high up—real substantial work, such as grinding corn or thrashing it, or turning wood or sawing it. On the other hand, there is no work at all to be got from a pond of water that is low down. [By virtue of the force of gravity] a stone high up, or a head of water, is in a position of advantage, and has the power of doing work as it falls to a lower level. But there are other forces besides gravity, and, with respect to these, bodies may be in a position of advantage and be able to do work just as truly as the stone, or the head of water, in the case before mentioned.

Let us take, for instance, the force of elasticity, and consider what happens in a crossbow. When this is bent, the bolt is evidently in a position of advantage with regard to the elastic force of the bow; and, when it is discharged, this energy of position of the bolt is converted into energy of motion, just as, when a stone on the top of a house is allowed to fall, its energy of position is converted into that of actual motion.

In like manner a watch wound up is in a position of advantage with respect to the elastic force of the mainspring, and as the

wheels of the watch move, this is gradually converted into energy of motion.—STEWART *The Conservation of Energy*, ch. 2, p. 377. (Hum., 1880.)

1016. ——— ——— *Water-wheel vs. Windmill—Accumulated Power Gives Independence—Analogy of Official or Social Position or Wealth in Human Life.*—It is, in fact, the fate of all kinds of energy of position to be ultimately converted into energy of motion.

The former may be compared to money in a bank, or capital, the latter to money which we are in the act of spending; and just as, when we have money in a bank, we can draw it out whenever we want it, so, in the case of energy of position, we can make use of it whenever we please. To see this more clearly, let us compare together a water-mill driven by a head of water and a windmill driven by the wind. In the one case we may turn on the water whenever it is most convenient for us, but in the other we must wait until the wind happens to blow. The former has all the independence of a rich man; the latter all the obsequiousness of a poor one. If we pursue the analogy a step further, we shall see that the great capitalist or the man who has acquired a lofty position is respected because he has the disposal of a great quantity of energy; and that whether he be a nobleman or a sovereign or a general in command, he is powerful only from having something which enables him to make use of the services of others. When the man of wealth pays a laboring man to work for him, he is in truth converting so much of his energy of position into actual energy, just as a miller lets out a portion of his head of water in order to do some work by its means.—STEWART *Conservation of Energy*, ch. 2, p. 378. (Hum., 1880.)

1017. ENERGY OF SUN—*Seemingly Undiminished—Immutability in the Midst of Change.*—Multiplying all our powers by millions of millions, we do not reach the sun's expenditure. And still, notwithstanding this enormous drain, in the lapse of human history we are unable to detect a diminution of his store. Measured by our largest terrestrial standards, such a reservoir of power is infinite; but it is our privilege to rise above these standards, and to regard the sun himself as a speck in infinite extension—a mere drop in the universal sea. We analyze the space in which he is immersed, and which is the vehicle of his power. We pass to other systems and other suns, each pouring forth energy like our own, but still without infringement of the law, which reveals immutability in the midst of change, which recognizes incessant transference or conversion, but neither final gain nor loss. The energy of Nature is a constant quality, and the utmost man can do in the pursuit of physical truth, or in the applications of physical knowledge, is to shift the constituents of the never-varying total, sacrificing one if he would produce another. The law of conservation rigidly excludes both creation and annihilation. Waves may change to ripples, and ripples to waves—magnitude may be substituted for number, and number for magnitude—asteroids may aggregate to suns, suns may invest their energy in floræ and faunæ, and floræ and faunæ may melt in air—the flux of power is eternally the same. It rolls in music through the ages, while the manifestations of physical life, as well as the display of physical phenomena, are but the modulations of its rhythm.—TYNDALL *Heat a Mode of Motion*, lect. 17, p. 535. (A., 1900.)

1018. ENERGY REQUIRED TO HOLD GASES TOGETHER IN WATER—Prior to experience, no one could suspect that two aeriform substances like oxygen and hydrogen could be obtained from water, and the discovery of the fact, near the beginning of this century, marks an era in the history of science. And even now, familiar as it is, this truth stands out as one of the most remarkable facts of Nature. Moreover, the wonder becomes still greater when we learn that water yields 1,800 times its volume of the two gases, and that these gases retain their aeriform condition so persistently that mechanical pressure alone cannot reduce them to the liquid condition; and still more the wonder grows when we learn further that the amount of energy required to decompose a pound of water into its constituent gases would be adequate to raise a weight of 5,314,200 pounds one foot high; and that, when these gases unite and the water is reproduced, this energy again becomes active.—COOKE *New Chemistry*, lect. 5, p. 114. (A., 1899.)

1019. ENERGY, SEEMING WASTE OF—*The Sun's Heat Poured into Empty Space—Might Warm Two Thousand Million Globes Like Ours.*—We have just seen the almost incomprehensible amount of heat which the sun must send the earth in order to warm its oceans and make green its continents; but how little this is to what passes by us! The earth as it moves on in its annual path continually comes into new regions, where it finds the same amount of heat already pouring forth; and this same amount still continues to fall into the empty space we have just quitted, where there is no one left to note it, and where it goes on in what seems to us utter waste. If, then, the whole annual orbit were set close with globes like ours, and strung with worlds like beads upon a ring, each would receive the same enormous amount the earth does now. But this is not all; for not only along the orbit, but above and below it, the sun sends its heat in seemingly incredible wastefulness, the final amount being expressible in the number of worlds like ours that it could warm like ours, which is 2,200,000,000.—LANGLEY *New Astronomy*, ch. 4, p. 95. (H. M. & Co., 1896.)

1020. ENERGY, THE CONSERVATION OF—The sum total of all causes working in Nature that can produce change in the physical world is as invariable as the totality of the store of matter. No manifestation of force can arise out of nothing, none can altogether disappear. All of the changes we observe consist in the fact that such a manifestation of force is expressed in some other way, it only assumes another form.—MEYER *Ueber Bestrebungen und Ziele der wissenschaftlichen Chemie*, p. 34. (Translated for *Scientific Side-Lights.)*

1021. ENERGY, THE FORM-GIVING ELEMENT IN MATTER—*Heat Makes the Difference between Solid, Liquid, and Gas.*—From the fact that all gases expand with heat and contract with cold, it is concluded that the ether-vibrations we term heat are the cause of the rapid motions of the gaseous molecules, and that if heat was entirely absent the motion would cease, and, ordinary cohesive attraction coming into play, the molecules would fall together and form a liquid or a solid. As a matter of fact, by intense cold, combined with pressure, all gases can be liquefied or solidified; and as, on the other hand, all the solid elements can be liquefied or vaporized by the intense heat of the electric furnace, we conclude that all matter when entirely deprived of heat is solid, and with sufficient heat becomes gaseous.—WALLACE *The Wonderful Century*, ch. 7, p. 55. (D. M. & Co., 1899.)

1022. ENGINEERING FEATS OF ANTIQUITY—*Power of Organized Labor—Time No Object.*—In the earliest engineering feats two facts must be sharply kept before the mind, to wit: That time was no object, and that there were no private buildings. Suppose that every laboring person in Chicago should be immediately withdrawn from all private work, and that they all should be organized to labor for ten years upon some government building as a memorial of the city's grandeur. One million hand-laborers would erect a pyramid containing fifteen thousand milliards of tons of earth, and the mechanics would put on the top of it a structure larger than all the monuments in Egypt combined.—MASON *Aboriginal American Mechanics (Memoirs of the International Congress of Anthropology*, p. 82). (Sch. P. C.)

1023. ENJOYMENT BY ILLUSION—*Made Happy by Attempting To Seem So.*—Let us examine one of these active illusions a little more fully. It would at first sight seem to be a perfectly simple thing to determine at any given moment whether we are enjoying ourselves, whether our emotional condition rises above the pleasure-threshold or point of indifference and takes on a positive hue of the agreeable or pleasurable. Yet there is good reason for supposing that people not unfrequently deceive themselves on this matter. It is, perhaps, hardly an exaggeration to say that most of us are capable of imagining that we are having enjoyment when we conform to the temporary fashion of social amusement. It has been cynically observed that people go into society less in order to be happy than to seem so, and one may add that in this semblance of enjoyment they may, provided they are not blasé, deceive themselves as well as others. The expectation of enjoyment, the knowledge that the occasion is intended to bring about this result, the recognition of the external signs of enjoyment in others—all this may serve to blind a man in the earlier stages of social amusement to his actual mental condition.—SULLY *Illusions*, ch. 8, p. 200. (A., 1897.)

1024. ENJOYMENT CONDUCIVE TO BENEVOLENCE—*Desire to Impart Pleasure.*—We do not conceive life to be so rich in enjoyments that it can afford to forego the cultivation of all those which address themselves to what M. Comte terms the egotistic propensities. On the contrary, we believe that a sufficient gratification of these, short of excess, but up to the measure which renders the enjoyment greatest, is almost always favorable to the benevolent affections. The moralization of the personal enjoyments we deem to consist, not in reducing them to the smallest possible amount, but in cultivating the habitual wish to share them with others, and with all others, and scorning to desire anything for oneself which is incapable of being so shared. There is only one passion or inclination which is permanently incompatible with this condition—the love of domination, or superiority, for its own sake; which implies, and is grounded on, the equivalent depression of other people. As a rule of conduct to be enforced by moral sanctions, we think no more should be attempted than to prevent people from doing harm to others, or omitting to do such good as they have undertaken. Demanding no more than this, society in any tolerable circumstances obtains much more; for the natural activity of human nature, shut out from all noxious directions, will expand itself in useful ones.—MILL *Positive Philosophy of Auguste Comte*, p. 131. (H. H. & Co., 1887.)

1025. ENJOYMENT OF NATURE LESS FREELY EXPRESSED IN GREEK THAN IN HEBREW POETRY—It has often been remarked that, altho the enjoyment derived from the contemplation of Nature was not wholly unknown to the ancients, the feeling was, nevertheless, much more rarely and less vividly expressed than in modern times. In his considerations on the poetry of the sentiments, Schiller thus expresses himself: "If we bear in mind the beautiful scenery with which the Greeks were surrounded, and remember the opportunities possessed by a people living in so genial a climate of entering into the free enjoyment of the contemplation of Nature, and observe how conformable were their mode of

thought, the bent of their imaginations, and the habits of their lives to the simplicity of Nature, which was so faithfully reflected in their poetic works, we cannot fail to remark with surprise how few traces are to be met among them of the sentimental interest with which we, in modern times, attach ourselves to the individual characteristics of natural scenery. The Greek poet is certainly, in the highest degree, correct, faithful, and circumstantial in his descriptions of Nature, but his heart has no more share in his words than if he were treating of a garment, a shield, or a suit of armor. Nature seems to interest his understanding more than his moral perceptions; he does not cling to her charms with the fervor and the plaintive passion of the poet of modern times." However much truth and excellence there may be in these remarks, they must not be extended to the whole of antiquity; and I moreover consider that we take a very limited view of antiquity when, in contradistinction to the present time, we restrict the term exclusively to the Greeks and Romans. A profound feeling of Nature pervades the most ancient poetry of the Hebrews and Indians, and exists, therefore, among nations of very different descent—Semitic and Indo-Germanic.—HUMBOLDT *Cosmos*, vol. ii, pt. i, p. 21. (H., 1897.)

1026. ENTHUSIASM OF YOUNG NATURALIST—*Fossil Winged Fish.*—Of all the organisms of the system [the Old Red Sandstone], one of the most extraordinary . . . is the *Pterichthys*, or winged fish, an ichthyolite which the writer had the pleasure of introducing to the acquaintance of geologists nearly three years ago, but which he first laid open to the light about seven years earlier. . . . I fain wish I could communicate to the reader the feeling with which I contemplated my first specimen. It opened with a single blow of the hammer; and there, on a ground of light-colored limestone, lay the effigy of a creature fashioned apparently out of jet, with a body covered with plates, two powerful looking arms, articulated at the shoulders, a head as entirely lost in the trunk as that of the ray or the sunfish, and a long, angular tail. My first-formed idea regarding it was, that I had discovered a connecting link between the tortoise and the fish—the body much resembles that of a small turtle; and why, I asked, if one formation gives us sauroid fishes, may not another give us chelonian ones? or if in the Lias we find the body of the lizard mounted on the paddles of the whale, why not find in the Old Red Sandstone the body of the tortoise mounted in a somewhat similar manner? The idea originated in error; but as it was an error which not many naturalists could have corrected at the time, it may be deemed an excusable one, more especially by such of my readers as may have seen well-preserved specimens of the creature.—MILLER *The Old Red Sandstone*, ch. 3, p. 42. (G. & L., 1851.)

1027. ——— ——— *Traces of the Ice-period in America.*—In the autumn of 1846, six years after my visit to Great Britain in search of glaciers, I sailed for America. When the steamer stopped at Halifax, eager to set foot on the new continent so full of promise for me, I sprang on shore and started at a brisk pace for the heights above the landing. On the first undisturbed ground, after leaving the town, I was met by the familiar signs, the polished surfaces, the furrows and scratches, the line-engraving of the glacier, so well known in the Old World; and I became convinced of what I had already anticipated as the logical sequence of my previous investigations, that here also this great agent had been at work, altho it was only after a long residence in America, and repeated investigations of the glacial phenomena in various parts of the country, that I fully understood the universality of its action.—AGASSIZ *Geological Sketches*, ser. ii, p. 77. (H. M. & Co., 1896.)

1028. ENTOMOLOGIST DECEIVED—*Protective Mimicry of Caterpillars.*—Some of the most curious examples of minute imitation are afforded by the caterpillars of the geometer moths, which are always brown or reddish, and resemble in form little twigs of the plant on which they feed. They have the habit, when at rest, of standing out obliquely from the branch, to which they hold on by their hind pair of prolegs or claspers, and remain motionless for hours. Speaking of these protective resemblances Mr. Jenner Weir says: "After being thirty years an entomologist I was deceived myself, and took out my pruning-scissors to cut from a plum-tree a spur which I thought I had overlooked. This turned out to be the larva of a geometer two inches long. I showed it to several members of my family, and defined a space of four inches in which it was to be seen, but none of them could perceive that it was a caterpillar."—WALLACE *Darwinism*, ch. 8, p. 139. (Hum., 1889.)

1029. ENVIRONMENT, ADAPTATION TO CHANGES OF—*Stomach of Sea-gull—Gizzard of Pigeon.*—Hunter, for example, in a classical experiment, so changed the environment of a sea-gull by keeping it in captivity that it could only secure a grain diet. The effect was to modify the stomach of the bird, normally adapted to a fish diet, until in time it came to resemble in structure the gizzard of an ordinary grain-feeder, such as the pigeon. Holmgrén, again, reversed this experiment by feeding pigeons for a lengthened period on a meat diet, with the result that the gizzard became transformed into the carnivorous stomach.—DRUMMOND *Natural Law in the Spiritual World*, essay 7, p. 232. (H. Al.)

1030. ENVIRONMENT AFFECTING MAN—*Adaptation of Races to Climate and Locality.*—That certain races are constitutionally fit and others unfit for certain climates,

is a fact which the English have but too good reason to know, when on the scorching plains of India they themselves become languid and sickly, while their children have soon to be removed to some cooler climate that they may not pine and die. It is well known also that races are not affected alike by certain diseases. While in Equatorial Africa or the West Indies the coast fever and yellow fever are so fatal or injurious to the new-come Europeans, the negroes and even mulattoes are almost untouched by this scourge of the white nations. On the other hand, we English look upon measles as a trifling complaint, and hear with astonishment of its being carried into Fiji, and there, aggravated no doubt by improper treatment, sweeping away the natives by thousands. It is plain that nations moving into a new climate, if they are to flourish, must become adapted in body to the new state of life; thus in the rarefied air of the high Andes more respiration is required than in the plains, and in fact tribes living there have the chest and lungs developed to extraordinary size. Races, tho capable of gradual acclimatization, must not change too suddenly the climate they are adapted to. With this adaptation to particular climates the complexion has much to do, fitting the negro for the tropics and the fair-white for the temperate zone; tho, indeed, color does not always vary with climate, as where in America the brown race extends through hot and cold regions alike. Fitness for a special climate, being matter of life or death to a race, must be reckoned among the chief of race-characters.—TYLOR *Anthropology*, ch. 3, p. 73. (A., 1899.)

1031. ENVIRONMENT ALONE DOES NOT DEVELOP GENIUS—The remarkable scientific activity manifested by the Arabs in all branches of practical astronomy is to be ascribed less to native than to Chaldean and Indian influences. Atmospheric conditions merely favored that which had been called forth by mental qualifications, and by the contact of highly gifted races with more civilized neighboring nations. How many rainless portions of tropical America enjoy a still more transparent atmosphere than Egypt, Arabia, and Bokhara! A tropical sky, and the eternal clearness of the heavens, radiant in stars and nebulous spots, undoubtedly everywhere exercise an influence on the mind, but they can only lead to thought, and to the solution of mathematical propositions, where other internal and external incitements, independent of climatic relation, affect the national character, and where the requirements of religious and agricultural pursuits make the exact division of time a necessity prompted by social conditions. Among calculating commercial nations (as the Phenicians), among constructive nations, partial to architecture and the measurement of land (as the Chaldeans and Egyptians), empirical rules of arithmetic and geometry were early discovered; but these are merely capable of preparing the way for the establishment of mathematical and astronomical science. It is only in the later phases of civilization that the established regularity of the changes in the heavens is known to be reflected in terrestrial phenomena. . . . The conviction entertained in all climates of the regularity of the planetary movements has contributed more than anything else to lead man to seek similar laws of order in the moving atmosphere, in the oscillations of the ocean, in the periodic course of the magnetic needle, and in the distribution of organisms over the earth's surface.—HUMBOLDT *Cosmos*, vol. ii, pt. ii, p. 221. (H., 1897.)

1032. ENVIRONMENT, ARTIFICIAL, A BONDAGE—*Possessions May Possess.*—Only to a certain extent does possession make a man freer, more independent. A step farther and possession becomes master, the possessor a slave required to sacrifice his time and thought, and find himself responsible to connections, nailed to place, incorporated in a state, all of which may be opposed to the essential requirements of his inmost nature.—SCHOPENHAUER, according to SCHWARZ, *Psychologie des Willens, a Lecture.* (Translated for *Scientific Side-Lights.)*

1033. ENVIRONMENT, BIRD'S CORRESPONDENCE WITH—*Man a Mass of Correspondences.*—The bird, again, which is higher in the scale of life, corresponds with a wider environment. The stream is real to it, and the insect. It knows what lies behind the hill; it listens to the love-song of its mate. And to much besides beyond the simple world of the tree this higher organism is alive. The bird, we should say, is more living than the tree; it has a correspondence with a larger area of environment. But this bird-life is not yet the highest life. Even within the immediate bird-environment there is much to which the bird must still be held to be dead. Introduce a higher organism, place man himself within this same environment, and see how much more living he is. A hundred things which the bird never saw in insect, stream, and tree appeal to him. Each single sense has something to correspond with. Each faculty finds an appropriate exercise. Man is a mass of correspondences, and because of these, because he is alive to countless objects and influences to which lower organisms are dead, he is the most living of all creatures. —DRUMMOND *Natural Law in the Spiritual World*, essay 4, p. 139. (H. Al.)

1034. ENVIRONMENT CANNOT ORIGINATE ADAPTATION—*Tubular Flower Cannot Produce Humming-bird's Bill.*—But correlation in this sense [*i. e.*, between different parts of the same organism] helps but a little way indeed in conceiving the origin of a new species. There might be the most minute and perfect harmony between

the changes effected in an animal newly born without those changes tending even in the most remote degree towards the establishment of a new form of life. In order to that establishment there must be another correlation, and a correlation of a higher kind. There must be a correlation between those changes and all the outward conditions amidst which the new form is to be placed and live. If this correlation fails the new form will die. Yet, so far as we can see, this kind of correlation is without any physical cause. It is not necessarily involved, as the other kind of correlation is, in the very idea of growth. On the contrary, it is not only entirely separable in thought, but, as we see in monstrosities, it is sometimes separated in fact. We have no conception of any force emanating from external things which shall mold the structure of an organism in harmony with themselves. Mr. Darwin freely confesses this, and says that many considerations "incline him to lay very little weight on the direct action of the conditions of life" in producing variety of form. We can conceive, dimly indeed, but still we can conceive, how in the humming-birds a special form of wing shall be correlated with a special form of bill. But we have no conception whatever how a special form of bill should be correlated with a special form of flower from which the bill is to extract its food. Mr. Darwin has shown how an improved bill, when once produced, will be preserved by finding external conditions to which it is adapted. But he has not shown, and he frankly confesses he has no idea, how the adapted variation of bill comes to be born at all.—ARGYLL *Reign of Law*, ch. 5, p. 149. (Burt.)

1035. ENVIRONMENT CHANGED BY EVOLUTION—*A Continually New Environment as One Climbs the Mountain.*—For what is most of all essential to remember is that not only is environment the prime factor in development, but that the environment itself rises with every evolution of any form of life. To regard the environment as a fixed quantity and a fixed quality is, next to ignoring the altruistic factor, the cardinal error of evolutional philosophy. With every step a climber rises up a mountain-side his environment must change.—DRUMMOND *Ascent of Man*, ch. 10, p. 325. (J. P., 1900.)

1036. ENVIRONMENT, CORRESPONDENCE WITH—*Man May Change Environment—Intelligent Volition May Secure More of Life.*—The essential characteristic of a living organism, according to these definitions [of Herbert Spencer's "Principles of Biology," vol. i, p. 74], is that it is in vital connection with its general surroundings. A human being, for instance, is in direct contact with the earth and air, with all surrounding things, with the warmth of the sun, with the music of birds, with the countless influences and activities of Nature and of his fellow men. In biological language, he is said thus to be "in correspondence with his environment." . . . Now it is in virtue of this correspondence that he is entitled to be called alive. So long as he is in correspondence with any given point of his environment, he lives. To keep up this correspondence is to keep up life. If his environment changes he must instantly adjust himself to the change. And he continues living only as long as he succeeds in adjusting himself to the "simultaneous and successive changes in his environment" as these occur. What is meant by a change in his environment may be understood from an example, which will at the same time define more clearly the intimacy of the relation between environment and organism. Let us take the case of a civil-servant whose environment is a district in India. It is a region subject to occasional and prolonged droughts resulting in periodical famines. When such a period of scarcity arises, he proceeds immediately to adjust himself to this external change. Having the power of locomotion, he may remove himself to a more fertile district, or, possessing the means of purchase, he may add to his old environment by importation the "external relations" necessary to continued life. But if from any cause he fails to adjust himself to the altered circumstances, his body is thrown out of correspondence with his environment, his "internal relations" are no longer adjusted to his "external relations," and his life must cease.—DRUMMOND *Natural Law in the Spiritual World*, essay 4, p. 132. (H. Al.)

1037. ENVIRONMENT, RELATIONS OF ANIMAL TO—The relation between animals and their environment is now a question of such great interest and importance that it is necessary in any description of the fauna of a particular region to consider its physical conditions and the influence that it may be supposed to have had in producing the characteristics of the fauna.—HICKSON *Fauna of the Deep Sea*, ch. 2, p. 18. (A., 1894.)

1038. ENVIRONMENT, SINFUL, CONTACT WITH—*Linked to Evil by a Single Correspondence.*—As a general rule men are linked to evil mainly by a single correspondence. Few men break the whole law. Our natures, fortunately, are not large enough to make us guilty of all, and the restraints of circumstances are usually such as to leave a loophole in the life of each individual for only a single habitual sin. But it is very easy to see how this reduction of our intercourse with evil to a single correspondence blinds us to our true position. Our correspondences, as a whole, are not with evil, and in our calculations as to our spiritual condition we emphasize the many negatives rather than the single positive. One little weakness, we are apt to fancy, all men must be allowed, and we even claim a

certain indulgence for that apparent necessity of nature which we call our besetting sin. Yet to break with the lower environment at all, to many, is to break at this single point. It is the only important point at which they touch it, circumstances or natural disposition making habitual contact at other places impossible. The sinful environment, in short, to them means a small but well-defined area. Now if contact at this point be not broken off, they are virtually in contact still with the whole environment.—DRUMMOND *Natural Law in the Spiritual World*, essay 5, p. 167. (H. Al.)

1039. ENVIRONMENT, SPIRITUAL—*Lack of Correspondence is Spiritual Death.*—Now follows a momentous question. Is man in correspondence with the whole environment? When we reach the highest living organism, is the final blow dealt to the kingdom of death? Has the last acre of the infinite area been taken in by his finite faculties? Is his conscious environment the whole environment? Or is there, among these outermost circles, one which with his multitudinous correspondences he fails to reach. If so, this is death. The question of life or death to him is the question of the amount of remaining environment he is able to compass. If there be one circle or one segment of a circle which he yet fails to reach, to correspond with, to know, to be influenced by, he is, with regard to that circle, or segment, dead.—DRUMMOND *Natural Law in the Spiritual World*, essay 4, p. 140. (H. Al.)

1040. ENVIRONMENT, SUITABLE, A NECESSITY OF LIFE—*Injurious Organisms Live Only Where They Find a Favorable Medium Awaiting Them.*—In the very earliest days of the study of micro-organisms it was observed that they mostly congregate where there is pabulum for their nourishment. The reason why fluids such as milk, and dead animal matter such as a carcass, and living tissues such as a man's body contain so many microbes is because each of these three media is favorable to their growth. Milk affords almost an ideal food and environment for microbes. Its temperature and constitution frequently meet their requirements. Dead animal matter, too, yields a rich diet for some species (saprophytes). In the living tissues bacteria obtain not only nutriment, but a favorable temperature and moisture. Outside the human body it has been the endeavor of bacteriologists to provide media as like the above as possible, and containing many of the same elements of food. Thus the life-history may be carried on outside the body and under observation. —NEWMAN *Bacteria*, ch. 1, p. 20. (G. P. P., 1899.)

1041. ——— ——— *Requisites for Natural Life—Conditions of Vitality.*—To understand the sustaining influence of environment in the animal world, one has only to recall what the biologist terms the extrinsic or subsidiary conditions of vitality. Every living thing normally requires for its development an environment containing air, light, heat, and water. In addition to these, if vitality is to be prolonged for any length of time, and if it is to be accompanied with growth and the expenditure of energy, there must be a constant supply of food. When we simply remember how indispensable food is to growth and work, and when we further bear in mind that the food-supply is solely contributed by the environment, we shall realize at once the meaning and the truth of the proposition that without environment there can be no life. Seventy per cent. at least of the human body is made of pure water, the rest of gases and earths. These have all come from environment. Through the secret pores of the skin two pounds of water are exhaled daily from every healthy adult. The supply is kept up by environment. The environment is really an unappropriated part of ourselves. Definite portions are continuously abstracted from it and added to the organism. And so long as the organism continues to grow, act, think, speak, work, or perform any other function demanding a supply of energy, there is a constant, simultaneous, and proportionate drain upon its surroundings.—DRUMMOND *Natural Law in the Spiritual World*, essay 7, p. 234. (H. Al.)

1042. ——— ——— *Requisites for Spiritual Life—The Soul's Environment God.*—In the spiritual world especially, he will be wise who courts acquaintance with the most ordinary and transparent facts of Nature; and in laying the foundations for a religious life he will make no unworthy beginning who carries with him an impressive sense of so obvious a truth as that without environment there can be no life. For what does this amount to in the spiritual world? Is it not merely the scientific restatement of the reiterated aphorism of Christ. "Without Me ye can do nothing"? There is in the spiritual organism a principle of life; but that is not self-existent. It requires a second factor, a something in which to live and move and have its being, an environment. Without this it cannot live or move or have any being. Without environment the soul is as the carbon without the oxygen, as the fish without the water, as the animal frame without the extrinsic conditions of vitality. And what is the spiritual environment? It is God. Without this, therefore, there is no life, no thought, no energy, nothing—"without Me ye can do nothing."—DRUMMOND *Natural Law in the Spiritual World*, essay 7, p. 237. (H. Al.)

1043. EPOCH CREATED BY GREAT DISCOVERIES—*The Telescope, Jupiter's Satellites, the Disk of Venus, Gravitation.*—The whole of the seventeenth century, whose commencement was brilliantly signalized by the great discovery of the telescope, together with the immediate results by which it was

attended—from Galileo's observation of Jupiter's satellites, of the crescentic form of the disk of Venus, and the spots on the sun, to the theory of gravitation discovered by Newton—ranks as the most important epoch of a newly created physical astronomy. This period constitutes, therefore, from the unity of the efforts made toward the observation of the heavenly bodies, and in mathematical investigations, a sharply defined section in the great process of intellectual development, which, since then, has been characterized by an uninterrupted progress.—HUMBOLDT *Cosmos*, vol. ii, pt. ii, p. 201. (H., 1897.)

1044. EPOCHS, BREACHES OF CONTINUITY—*Sudden Developments of Human Power—Great Men in Clusters.*—It is an order of facts observable in the progress of mankind, that long ages of comparative silence and inaction are broken up, and brought to an end, by shorter periods of almost preternatural activity. And that activity is generally spent in paths of investigation, which, tho independent, are converging. Different minds, pursuing different lines of thought, find themselves meeting upon common ground. Such, in respect to literature, was the period of the Revival of Learning: such, in respect to religion, was the period of the Reformation; such, in respect to the abstract sciences, was the period of Tycho Brahe, of Galileo, and Kepler. Hardly less memorable than these, certainly not less powerful, as affecting the condition of society, were those few years in the last quarter of the eighteenth century which were marked by such an extraordinary burst of mechanical invention. Hargreaves, and Arkwright, and Watt, and Crompton, and Cartwright were all contemporaries. They were all working at the same time, and in the same direction. Out of their inventions there arose for the first time what is now known as the factory system; and out of the factory system arose a condition of things, as affecting human labor, which was entirely new in the history of the world.—ARGYLL *Reign of Law*, ch. 7, p. 204. (Burt.)

1045. EQUALITY, MENTAL, A DELUSION—*Cruel Result of Such Belief—Tyranny of Bad Mental Organization.*—Perhaps of all the erroneous notions concerning mind which metaphysics has engendered or abetted, there is none more false than that which tacitly assumes or explicitly declares that men are born with equal original mental capacity; opportunities and education determining the differences of subsequent development. The opinion is as cruel as it is false. What man can by taking thought add one cubit either to his mental or to his bodily stature? Multitudes of human beings come into the world weighted with a destiny against which they have neither the will nor the power to contend; they are the step-children of Nature, and groan under the worst of all tyrannies—the tyranny of a bad organization. Men differ, indeed, in the fundamental characters of their minds, as they do in the features of their countenances, or in the habits of their bodies; and between those who are born with the potentiality of a full and complete mental development, under favorable circumstances, and those who are born with an innate incapacity of mental development, under any circumstances, there exists every gradation. What teaching could ever raise the congenital idiot to the common level of human intelligence? What teaching could ever keep the inspired mind of the man of genius at that level?—MAUDSLEY *Body and Mind*, lect. 2, p. 43. (A., 1898.)

1046. EQUILIBRIUM OF NATURE—*Chance Does Not Give Order and Progress—The Loaded Dice.*—It has been well said that if a pair of dice were to turn up aces a hundred times in succession, any reasonable spectator would conclude that they were loaded dice; so if countless millions of atoms and thousands of species, each including within itself most complex arrangement of parts, turn up in geological time in perfectly regular order and a continued gradation of progress, something more than chance must be implied. It is to be observed here that every species of animal or plant, of however low grade, consists of many coordinated parts in a condition of the nicest equilibrium. Any change occurring which produces unequal or disproportionate development, as the experience of breeders of abnormal varieties of animals and plants abundantly proves, imperils the continued existence of the species. Changes must, therefore, in order to be profitable, affect the parts of the organism simultaneously and symmetrically. The chances of this may well be compared to the casting of aces a hundred times in succession, and are so infinitely small as to be incredible under any other supposition than that of intelligent design.—DAWSON *Facts and Fancies in Modern Science*, lect. 3, p. 122. (A. B. P. S.)

1047. EQUIPMENT FOR DESTRUCTION—*Deceptive Coloration among Birds.*—Deceptive, or, as Poulton terms it, "aggressive" coloration is perhaps best illustrated by common flycatchers (*Tyrannidæ*). Altho these birds live in and about trees, they are, as a rule, quietly attired in olive-green or olive-gray, and are quite unlike the brilliantly clad, fruit-eating tanagers, orioles, parrots, and other birds that may be found near them. Insects are therefore more likely to come within snapping distance than if these birds were conspicuously colored. In the same manner we may explain the colors of hawks, which are never brightly plumaged. It is well known that many arctic animals become white on the approach of winter. With ptarmigans this is doubtless an instance of protective coloration, but the

snowy owl, who feeds on the ptarmigan, may be said to illustrate deceptive coloration.—CHAPMAN *Bird-Life*, ch. 3, p. 44. (A., 1900.)

1048. EQUIVALENCE OF FORCES—*Heat and Electricity.*—If I should set an emery-wheel to revolving and hold a piece of steel against it, the piece of steel would become heated and incandescent particles would fly off, making a brilliant display of fireworks. The heat that has been developed is the measure of the mechanical energy that I have used against the emery-wheel. Now, let us substitute for the emery-wheel another wheel of the same size made of vulcanized rubber, glass, or resin. I set it to revolving at the same speed, and instead of the piece of steel, I now hold a silk handkerchief or a catskin against the wheel with the same force that I did the steel. If now I provide a Leyden jar and some points to gather up the electricity that will be produced (instead of the heat generated in the other case), it would be found that the energy developed in the one case would exactly balance that of the other, if it were all gathered up and put into work. The electricity stored in the jar is in a state of strain, like a bent bow, and will recoil, when it has a chance, with a power commensurate with the time it has been storing and the amount of energy used in pressing against the wheel. If now I connect my two hands, one with the inside and the other with the outside of the jar, this stored energy will strike me with a force equal to all the energy I have previously expended in pressing against the wheel, minus the loss in heat. If I did it for a long enough time this electrical spring would be wound up to such a tension that the recoil would destroy life if one put himself in the path of its discharge.—ELISHA GRAY *Nature's Miracles*, vol. iii, ch. 5, p. 44. (F. H. & H., 1900.)

1049. EROSION BY SAND-LADEN WATER—*Minute Particles Cut through Solid Cliff—Mighty Effect from Trivial Cause.*—This power of erosion, so strikingly displayed when sand is urged by air, renders us better able to conceive its action when urged by water. The erosive power of a river is vastly augmented by the solid matter carried along with it. Sand or pebbles, caught in a river vortex, can wear away the hardest rock; "pot-holes" and deep cylindrical shafts being thus produced. An extraordinary instance of this kind of erosion is to be seen in the Val Tournanche, above the village of this name. The gorge at Handeck has been thus cut out.—TYNDALL *Fragments of Science*, vol. i, ch. 7, p. 196. (A., 1900.)

1050. ERROR, CUMULATIVE RESULT OF—*Slight Inaccuracy Vitiates All Results in Space and Time.*—Our estimates of the masses of the heavenly bodies also depend upon a knowledge of the sun's distance from the earth. The quantity of matter in a star or planet is determined by calculations whose fundamental data include the distance between the investigated body and some other body whose motion is controlled or modified by it; and this distance generally enters into the computation by its cube, so that any error in it involves a more than threefold error in the resulting mass. An uncertainty of one per cent. in the sun's distance implies an uncertainty of more than three per cent. in every celestial mass and every cosmical force.

Error in this fundamental element propagates itself in time also, as well as in space and mass. . . . If, for instance, we should find as the result of calculation with the received data, that two millions of years ago the eccentricity of the earth's orbit was at a maximum, and the perihelion so placed that the sun was nearest during the northern winter (a condition of affairs which it is thought would produce a glacial epoch in the southern hemisphere), it might easily happen that our results would be exactly contrary to the truth, and that the state of affairs indicated did not occur within ten thousand years of the specified date—and all because in our calculation the sun's distance, or the solar parallax by which it is measured, was assumed half of one per cent. too great or too small.—YOUNG *The Sun*, ch. 2, p. 11. (A., 1898.)

1051. ERROR, DEFINITE, MORE HELPFUL THAN INDECISION—None of Bacon's aphorisms shows a clearer insight into the relations between the human mind and the external world than that which declares ["Novum Organum," lib. ii, aph. 20], "Truth to emerge sooner from error than from confusion." A definite theory (even if a false one) gives holding-ground to thought. Facts acquire a meaning with reference to it. It affords a motive for accumulating them and a means of coordinating them; it provides a framework for their arrangement, and a receptacle for their preservation, until they become too strong and numerous to be any longer included within arbitrary limits, and shatter the vessel originally framed to contain them.

Such was the purpose subserved by Herschel's theory of the sun. It helped to clarify ideas on the subject. The turbid sense of groping and viewless ignorance gave place to the lucidity of a plausible scheme.—CLERKE *History of Astronomy*, pt. i, ch. 3, p. 67. (Bl., 1893.)

1052. ERROR, HONEST, LEADS TO KNOWLEDGE—*Alchemists Discover Chemistry — Atoms in Greek Philosophy.*—The Greek philosophers expressed their ideas of the states of matter by the four elements, fire, air, water, earth; and they also had learned or invented the doctrine of matter being made up of atoms—a principle now more influential than ever in modern lecture-rooms. The successors of the Greeks were the Arabic alchemists, and their dis-

ciples in medieval Christendom. Their belief that matter might be transmuted or transformed led many of them to spend their lives among their furnaces and alembics in the attempt to turn baser metals into gold. To modern chemists, who would not be surprised to find all the many so-called elements proved to be forms of one matter, the alchemists' idea does not seem quite unreasonable in itself, and practically it led them to the pursuit of truth by experiment, so that tho they found no philosopher's stone, they were repaid by discoveries such as alcohol, ammonia, sulfuric acid. Their method, being founded on trials of real fact, cleared itself more and more from the magical folly it had grown up with, and the alchemist prepared the way for the later chemist.—TYLOR *Anthropology*, ch. 13, p. 328. (A., 1899.)

1053. ERROR INSEPARABLE FROM INVESTIGATION—Cope has been much criticized for the mistakes and false generalizations he made. Unquestionably he did make many. But error seems to be inseparable from investigation, and if he made more than the other great masters, he covered more ground and did more work. He was also, it must be admitted, more hasty than some others in that he availed himself of the more frequent means of publication he enjoyed.—GILL *Proc. Amer. Assoc. for the Advancement of Science*, vol. xlvi. (1897.)

1054. ERROR MAGNIFIED IN POPULAR BELIEF—*Supposed Hollow Interior of the Earth—"Symmes's Hole."*—Leslie has ingeniously conceived the nucleus of the world to be a hollow sphere, filled with an assumed "imponderable matter, having an enormous force of expansion." These venturesome and arbitrary conjectures have given rise, in wholly unscientific circles, to still more fantastic notions. The hollow sphere has by degrees been peopled with plants and animals, and two small subterranean revolving planets—Pluto and Proserpine—were imaginatively supposed to shed over it their mild light; as, however, it was further imagined that an ever-uniform temperature reigned in these internal regions, the air, which was made self-luminous by compression, might well render the planets of this lower world unnecessary. Near the north pole, at 82° latitude, whence the polar light emanates, was an enormous opening, through which a descent might be made into the hollow sphere, and Sir Humphry Davy and myself were even publicly and frequently invited by Captain Symmes to enter upon this subterranean expedition: so powerful is the morbid inclination of men to fill unknown spaces with shapes of wonder, totally unmindful of the counter-evidence furnished by well-attested facts and universally acknowledged natural laws.—HUMBOLDT *Cosmos*, vol. i, p. 171. (H., 1897.)

1055. ERROR OF CLAIMING TOO MUCH—*Unsupported Assumptions Discredit True Doctrines—The Atomic Theory Overloaded.*—Speculators have often erred in attempting to elaborate their hypotheses too fully, and, by making assumptions which have afterwards proved to be improbable or untenable, have brought discredit on views which, in their essentials, were of great value. . . . All we can say at present is that by no chemical or physical process known to us do atoms undergo division or transformation to an extent appreciable by chemical methods. An atom of carbon always acts with the combining weight 12; if it consist of several independent parts, we do not know it, because, in all reactions thus far known, these parts always act together. The idea of the transmutation of the elements, while resting at present on a very slender basis, is entirely justifiable as a working hypothesis.—STOKES *The Atomic Theory from the Chemical Standpoint in Science*. N. S. vol. xi, No. 277, Apr. 20, 1900.

1056. ERROR ONCE UNIVERSAL—*Frogs, Eels, Shell-fish, Caterpillars, Serpents, Rats, and Mice Credited with Spontaneous Generation.*—The checks which experience alone can furnish being absent, the spontaneous generation of creatures quite as high as the frog in the scale of being was assumed for ages to be a fact. Here, as elsewhere, the dominant mind of Aristotle stamped its notions on the world at large. For nearly twenty centuries after him men found no difficulty in believing in cases of spontaneous generation which would now be rejected as monstrous by the most fanatical supporter of the doctrine. Shell-fish of all kinds were considered to be without parental origin. Eels were supposed to spring spontaneously from the fat ooze of the Nile. Caterpillars were the spontaneous products of the leaves on which they fed; while winged insects, serpents, rats, and mice were all thought capable of being generated without sexual intervention.—TYNDALL *Fragments of Science*, vol. ii, ch. 13, p. 290. (A., 1900.)

1057. ERRORS OF EDUCATORS—*Man Viewed as an Instrument—Knowledge Valued More than Culture.*—Now the various opinions which prevail concerning the comparative utility of human sciences and studies, have all arisen from two errors. The first of these consists in viewing man, not as an end unto himself, but merely as a mean organized for the sake of something out of himself; and, under this partial view of human destination, those branches of knowledge obtain exclusively the name of useful which tend to qualify a human being to act the lowly part of a dexterous instrument. The second, and the more dangerous of these errors, consists in regarding the cultivation of our faculties as subordinate to the acquisition of knowledge, instead of regarding the possession of knowledge as subordinate to the cultivation of our faculties; and, in consequence of this error, those sciences which afford a greater number of

more certain facts have been deemed superior in utility to those which bestow a higher cultivation on the higher faculties of the mind.—HAMILTON *Metaphysics*, lect. 1, p. 3. (G. & L., 1859.)

1058. ERRORS OF SCIENTISTS—*A Classification that Would Include the Hog among Ruminants.*—Cuvier taught that there was always a coordination between the various systems of the animal frame and that, from the remains or impress of one part, the approximate structure of the other parts could be inferred. He even pushed this doctrine to such an extreme that he overlooked some obvious counter-facts. One such case is so remarkable, because it originated with Cuvier and was indorsed by Huxley, that it is worthy of mention here, and Huxley's introduction to it and translation of it may be given [from his "Introduction to the Classification of Animals," 1869, ch. 1]:

" . . . I doubt if any one would have divined, if untaught by observation, that all ruminants have the foot cleft, and that they alone have it; . . . so that now, whoso sees merely the print of a cleft foot may conclude that the animal which left this impression ruminated, and this conclusion is as certain as any other in physics or morals."

Some men, with much less knowledge than either Cuvier or Huxley, may at once recall living exceptions to the positive statements as to the coordination of the "foot cleft" with the other characters specified. One of the most common of domesticated animals—the hog—would come up before the "mind's eye," if not the actual eye at the moment, to refute any such correlation as was claimed. Nevertheless, notwithstanding the fierce controversial literature centered on Huxley, no allusion appears to have been made to the *lapsus*. Yet every one will admit that the hog has the "foot cleft" as much as any ruminant, but the "form of the teeth" and the form of some vertebræ are quite different from those of the ruminants, and of course the multiple stomach and adaptation for rumination do not exist in the hog. That any one mammalogist should make such a slip is not very surprising, but that a second equally learned should follow in his steps is a singular psychological curiosity.—GILL *Edward Drinker Cope, Naturalist*, in *Proc. Amer. Assoc. for the Advancement of Science*, vol. xlvi, p. 17. (1897.)

1059. ——— ——— *All Nebulæ Once Supposed Resolvable—"Island Universes"—Correction of Error by Spectroscope.*—Altho Lord Rosse himself rejected the inference that because many nebulæ had been resolved, all are resolvable, very few imitated his truly scientific caution; and the results of Bond's investigations with the Harvard College refractor quickened and strengthened the current of prevalent opinion. It is now certain that the evidence furnished on both sides of the Atlantic as to the stellar composition of some conspicuous objects of this class, notably the Orion and "Dumb-bell" nebulæ, was delusive; but the spectroscope alone was capable of meeting it with a categorical denial. Meanwhile there seemed good ground for the persuasion, which now, for the last time, gained the upper hand, that nebulæ are, without exception, true "island universes," or assemblages of distant suns.—CLERKE *History of Astronomy*, pt. i, ch. 6, p. 147. (Bl., 1893.)

1060. ——— ——— *Astronomers Once Denied Satellites to Mars—Their Discovery by Persistent Search.*—We know now that this world [Mars] travels round the sun accompanied by two satellites. Their discovery was made in 1877, by Professor Asaph Hall, at the Observatory of Washington, by the aid of the most powerful telescope which existed at that time. It was not due to chance, like that of a great number of small planets and comets, but it was the result of a systematic search. Most astronomers were accustomed, like ordinary mortals, to read in the standard books the usual phrase, "Mars has no satellites"; however, some, doubting this assertion, continued to seek to surprise the secrets of Nature, which always keeps more than it allows us to grasp. They had already searched the neighborhood of Mars; but the instruments they used were much inferior to the equatorial of Washington, of which the object-glass measures no less than 66 centimeters (26 inches) in diameter, of which the focal length is 10 meters (32.8 feet), of which the optical power permits a magnification of 1,300 times, and which is moved by a mechanism of the greatest precision. By the aid of this excellent apparatus the eminent American astronomer undertook the attentive examination of the neighborhood of Mars from the beginning of the month of August, 1877, in order to observe assiduously this neighboring planet during the favorable epoch of its greatest proximity to the earth. After long evenings of barren expectation, he was about to abandon the search, when, encouraged by the entreaties of his wife, he persisted, and discovered a satellite during the night of the 11th, then a second on the night of the 17th.—FLAMMARION *Popular Astronomy*, bk. iv, ch. 4, p. 393. (A.)

1061. ——— ——— *Comets Styled "Visible Nothings"—Solidity of Meteorites—Nuclei of Comets.*—Ought we, then, to laugh at them [comets], and, with Sir John Herschel and Babinet, treat them as visible nothings? No; that would be the other extreme. Several comets seem to have solid nuclei. Solid bodies have already encountered the earth, have fallen on its surface, have killed men and set fire to houses. Most of the meteorites collected are, it is true, but small fragments of some few pounds in weight; but some have been met with which weigh several thousands of pounds. This is

not a question of principle, but only a relation of the little to the great. Now, bolides have been measured which have, so to say, grazed the earth, and which have been several miles in diameter. The nucleus of the comet of 1811 was 690 kilometers (428 miles) in diameter; that of the great comet of 1843 measured 8,000 kilometers (4,970 miles); that of the comet of 1858, 9,000 kilometers (5,580 miles); that of the comet of 1769 measured 44,000 kilometers (27,000 miles, 11,000 leagues) in diameter! Whatever may be the intrinsic nature of these nuclei, it is not doubtful that, if one of them were to encounter our globe in its passage, both moving with a velocity of more than 60,000 miles an hour, we should certainly perceive the shock.—FLAMMARION *Popular Astronomy*, bk. v, ch. 3, p. 529. (A.)

1062. ——— ——— *Emission Theory of Light—The Fallibility of Newton.*—Up to his demonstration of the composition of white light, Newton had been everywhere triumphant—triumphant in the heavens, triumphant on the earth—and his subsequent experimental work is, for the most part, of immortal value. But infallibility is not the property of man, and, soon after his discovery of the nature of white light, Newton proved himself human. He supposed that refraction and dispersion went hand in hand, and that you could not abolish the one without at the same time abolishing the other. Here Dollond corrected him. But Newton committed a graver error than this in deducing his emission theory of light, which he held to consist of material particles. . . . His experiments are imperishable, but his theory has passed away. For a century it stood like a dam across the course of discovery; but, like all barriers that rest upon authority, and not upon truth, the pressure from behind increased, and eventually swept the barrier away. This, as you know, was done mainly through the labors of Thomas Young, and his illustrious French fellow worker Fresnel.—TYNDALL *Lectures on Light*, lect. 6, p. 210. (A., 1898.)

1063. ——— ——— *Fall of Stones from the Sky Once Denied—Evidence Finally Accepted.*—A rather curious fact is that, altho the ancient traditions, the histories of antiquity and of the Middle Ages, and the popular beliefs had distinctly spoken of stones fallen from the sky, stones of the air, aerolites, the savants would not believe in them. Either they denied the fact itself, or they interpreted it quite otherwise, regarding the stones fallen on the earth as shot out by volcanic eruptions, raised from the ground by waterspouts, or even produced by certain condensations of matter in the midst of the atmosphere. In 1790 the illustrious Lavoisier, and in 1800 the whole Academy of Sciences, declared these facts to be absolutely apocryphal. In 1794 Chladni proved the extraterrestrial origin of these mysterious objects.

This almost general incredulity of the savants gave way when Biot read to the Academy of Sciences his report on the memorable fall which took place at Laigle, in the Department of the Orne, on April 26, 1803. After a minute inquiry made on the spot, the perfect accuracy of the circumstances related by public rumor of this very remarkable fall was verified. Numerous witnesses affirmed that some minutes after the appearance of a great bolide moving from southeast to northeast, and which had been perceived at Alençon, Caen, and Falaise, a fearful explosion, followed by detonations like the report of cannon and the fire of musketry, proceeded from an isolated black cloud in a very clear sky. A great number of meteoric stones were then precipitated on the surface of the ground, where they were collected, still smoking, over an extent of country which measured no less than seven miles in length. The largest of these stones weighed less than 10 kilograms (22 lbs.).—FLAMMARION *Popular Astronomy*, bk. v, ch. 4, p. 543. (A.)

1064. ——— ——— *False Results Confirming Each Other—The Sun's Distance.*—Dr. Matthew Stewart, Professor of Mathematics in the University of Edinburg, had made a futile attempt in 1763 to deduce the sun's distance from his disturbing power over our satellite. Tobias Mayer, of Göttingen, however, whose short career was so fruitful of suggestions, struck out the right way to the same end; and Laplace, in the seventh book of the "Mécanique Céleste," gave a solar parallax derived from the lunar "parallactic inequality" substantially identical with that issuing from Encke's subsequent discussion of the eighteenth-century transits. Thus two wholly independent methods—the trigonometrical, or method by survey, and the gravitational, or method by perturbation—seemed to corroborate each the upshot of the use of the other until the nineteenth century was well past its meridian. [It was refuted in 1854-58.] It is singular how often errors conspire to lead conviction astray.—CLERKE *History of Astronomy*, pt. ii, ch. 6, p. 284. (Bl., 1893.)

1065. ——— ——— *Herschel Recants His Earlier Views.*—I refer to the theory, which finds a place in all our text-books of astronomy, that the star-system has the form of a cloven flat disk. This theory was formed by Sir William Herschel when he was as yet unaware of the vastness and complexity of the star-system. The very words used in describing his process of research indicate that the great astronomer was full of confidence in the power of his great telescopes to fathom all the profundities of the sidereal system. He called his method star-gaging, he spoke of the distance at which the boundary of the star-system lay in this or that direction, and he discussed the numerical results he had obtained, without

doubting that those results really enabled him to determine the architecture of the galaxy.

But as the work progressed Sir William Herschel grew less confident. He began to recognize signs of a complexity of structure which set his method of star-gaging at defiance. It became more and more clear to him also, as he extended his survey, that the star-depths were in fact unfathomable—not only by his gaging telescope (commonly known as the twenty-feet reflector), but even by that mighty mirror which was one of the chief wonders of the world, until the great Rosse telescope dwarfed it into relative insignificance. At length Sir William Herschel definitely abandoned the principles on which his star-gaging had been based; and his observations, as well as his theoretical researches, were thenceforth directed to the determination of the general laws which prevail amid the star-depths.—PROCTOR *Our Place among Infinities*, p. 193. (L. G. & Co., 1897.)

1066. ——— ——— *Herschel's Conception of the Sun.*—A cool, dark, solid globe, its surface diversified with mountains and valleys, clothed in luxuriant vegetation, and "richly stored with inhabitants," protected by a heavy cloud-canopy from the intolerable glare of the upper luminous region, where the dazzling coruscations of a solar aurora some thousands of miles in depth evolved the stores of light and heat which vivify our world—such was the central luminary which Herschel constructed with his wonted ingenuity, and described with his wonted eloquence.—CLERKE *History of Astronomy*, pt. i, ch. 3, p. 65. (Bl., 1893.)

1067. ——— ——— *Liebig's Doctrine of Fermentation.*—Liebig insisted that all albuminoid bodies were unstable, and if left to themselves would fall to pieces—*i. e.*, ferment—without the aid of living organisms, or any initiative force greater than dead yeast-cells. It was at this juncture that Pasteur intervened to dispel the obscurities and contradictory theories which had been propounded.—NEWMAN *Bacteria*, ch. 4, p. 112. (G. P. P., 1899.)

1068. ——— ——— *Light Once Believed to Pass Instantly through Space—Newton's Error Regarding Refraction.*—By Römer's discovery, the notion entertained by Descartes, and espoused by Hooke, that light is propagated instantly through space, was overthrown. But the establishment of its motion through stellar space led to speculations regarding its velocity in transparent terrestrial substances. The index of refraction of a ray passing from air into water is $\frac{4}{3}$. Newton assumed these numbers to mean that the velocity of light in water being 4, its velocity in air is 3; and he deduced the phenomena of refraction from this assumption The reverse has since been proved to be the case—that is to say, the velocity of light in water being 3, its velocity in air is 4; but both in Newton's time and ours the same great principle determined, and determines, the course of light in all cases. In passing from point to point, whatever be the media in its path, or however it may be reflected, light takes the course which occupies least time.—TYNDALL *Lectures on Light*, lect. 1, p. 23. (A., 1898.)

1069. ——— ——— *Newton Held that Reflection and Refraction Could Not Be Separated—Dollond Proved the Contrary—The Achromatic Lens.*—Newton completed his proof [of the composite nature of white light] by synthesis in this way: The spectrum now before you is produced by a glass prism. Causing the decomposed beam to pass through a second similar prism, but so placed that the colors are refracted back and reblended, the perfectly white luminous disk is restored. In this case, refraction and dispersion are simultaneously abolished. Are they always so? Can we have the one without the other? It was Newton's conclusion that we could not. Here he erred, and his error, which he maintained to the end of his life, retarded the progress of optical discovery. Dollond subsequently proved that, by combining two different kinds of glass, the colors can be extinguished, still leaving a residue of refraction, and he employed this residue in the construction of achromatic lenses—lenses yielding no color—which Newton thought an impossibility.—TYNDALL *Lectures on Light*, lect. 1, p. 28. (A., 1898.)

1070. ——— ——— *Newton, Linnæus, Cuvier, Owen, Huxley, and Buffon.*—As Homer in the realm of poetry sometimes nods so there is hardly a man of science . . . who does not occasionally offer us some prosaic error. Thus Isaac Newton strangely boasted that he made no hypothesis, Linnæus classed together the walrus and the sloth, Cuvier fancied that from a fossil "foot" he could construct an extinct zoological "Hercules." Moreover, he strangely failed to understand the true affinities of the barnacle, nor were pouched beasts by any means correctly appreciated by him in spite of his zoological and anatomical genius. Our own "Prince of Anatomists," Owen, suffered ruefully from his failure to appreciate an ape's "Hippocampus Minor," while his vigorous opponent Huxley stood sponsor for that never-to-be-forgotten creature of the fancy, "Bathybius." Similarly, Buffon was led by his imagination to be at once unjust to Nature and to such a marvelous product of Nature as the sloth. [See ADAPTATION TO ENVIRONMENT—THE SLOTH.]—MIVART *Types of Animal Life*, ch. 9, p. 247. (L. B. & Co., 1893.)

1071. ——— ——— *Old Belief in Phlogiston—"Imponderable Agents."*—For years after Newton, the chemists believed universally in a kind of matter called phlogiston, which not only could be removed from a sub-

stance without diminishing its weight, but whose subtraction actually added to the weight. It is the great merit of Lavoisier that he . . . was the first to see clearly that, in every chemical process, increase of weight means increase of material, and loss of weight loss of material. Iron, in rusting, gains in weight. Hence, said Lavoisier, it has combined with some material. No, said the defenders of the phlogiston theory—such men as Cavendish, Priestly, and Scheele—it has only lost phlogiston. You are making too much of this matter of weight. Phlogiston differs from your gross forms of matter in that it is specifically light, and, when taken from a body, increases its weight. We smile at this idea, and we find it difficult to believe that these men, the first scientific minds of their age, could believe in such absurdity. But we must remember that the idea did not originate with them. It was a part of the old Greek philosophy, and from the pages of Aristotle was taught in every school of Europe until within two hundred years; and, even in our own time, we still hear of imponderable agents. Text-books of science are used in some of our schools which refer the phenomena of heat and electricity to attenuated forms of matter, that can be added to or subtracted from bodies without altering their weight. Such facts should teach us, not that we are so much wiser than our fathers, but that our familiar ideas of the composition of matter are not such simple deductions from the phenomena of Nature as they appear to us; and this discussion of the evidence, on which these conclusions are based, is therefore by no means superfluous.—COOKE *New Chemistry*, lect. 5, p. 112. (A., 1899.)

1072. ——— ——— *The Imagined "Phlogiston," the Principle of Fire.*—They [ancient philosophers] termed the principle of fire phlogiston, and burning, or the escape of fire, dephlogistication, and their ingenious system did not a little to retard the progress of truth. The philosophers of that age either took no account of the increase of weight which results from burning, or attempted to explain the few instances in which the fact was forced upon their attention by the fanciful notion of Aristotle—that the essence of fire was specifically light. Hence, they reasoned, phlogiston buoys up all bodies into which it enters, and after its escape in the process of burning, the burnt material must weigh more than before. It was not until 1783 that the true theory of combustion was discovered, and from this discovery modern chemistry dates. The fortunate discoverer was Lavoisier. He proved, by simply weighing the products of combustion, that burning, instead of being a loss of phlogiston, is a union of the burning substance with the oxygen of the air, and this theory is now one of the best established principles of science.—COOKE *Religion and Chemistry*, ch. 3, p. 78. (A., 1897.)

1073. ——— ——— *Theories Abandoned by Sir William Herschel—Change upon Evidence—Honest Avowal of the Change—The True Scientist Seeks Fact and Truth.*—[Herschel] wrote thus in 1802, seventeen years after he had enunciated the cloven-disk theory [which regards the sidereal universe as a cloven disk, which we look through edgewise in the Milky Way]: "Altho our sun and all the stars we see may truly be said to be in the plane of the Milky Way, yet I am now convinced by a long inspection and continued examination of it, that the Milky Way itself consists of stars very differently scattered from those which are immediately about us." And again in 1811 he said: "When the novelty of the subject is considered, we cannot be surprised that many things formerly taken for granted should, on examination, prove to be different from what they were generally, but incautiously, supposed to be. For instance, an equal scattering of the stars may be admitted in certain calculations; but when we examine the Milky Way, or the closely compressed clusters of stars, this supposed equality of scattering must be given up."—PROCTOR *Expanse of Heaven*, p. 260. (L. G. & Co., 1897.)

1074. ——— ——— *Theory Not a Safe Guide for Vital Processes—Bone-soup of French Academy.*—There are other juices besides the albumin; these are the most important of the flavoring constituents, and, with the other constituents of animal food, have great nutritive value; so much so that animal food is quite tasteless and almost worthless without them. I have laid especial emphasis on the above qualification, lest the reader should be led into an error originated by the bone-soup committee of the French Academy, and propagated widely by Liebig—that of regarding these juices as a concentrated nutriment when taken alone. They constitute collectively the *extractum carnis*, which, with the addition of more or less gelatin (the less the better), is commonly sold as Liebig's "Extract of Meat." It is prepared by simply mincing lean meat, exposing it to the action of cold water, and then evaporating down the solution of extract thus obtained.—WILLIAMS *Chemistry of Cookery*, ch. 3, p. 25. (A., 1900.)

1075. ——— ——— *The Theory of Catastrophism in Geology.*—Cuvier imagined that the whole history of the earth's crust, since the time when living creatures had first appeared on the surface, must be divided into a number of perfectly distinct periods, or divisions of time, and that the individual periods must have been separated from one another by peculiar revolutions of an unknown nature (cataclysms, or catastrophes). Each revolution was followed by the utter annihilation of the till then existing animals and plants, and after its termination a completely new creation of organic forms took place. A new world of

animals and plants, absolutely and specifically distinct from those of the preceding historical periods, was called into existence at once, and now again peopled the globe for thousands of years, till it again was suddenly destroyed in the crash of a new revolution.—HAECKEL *History of Creation*, vol. i, ch. 3, p. 60. (K. P. & Co., 1899.)

1076. ——— ——— *The Will Once Deemed a Separate Faculty.*—All our deeds were considered by the early psychologists to be due to a peculiar faculty called the will, without whose fiat action could not occur. Thoughts and impressions, being intrinsically inactive, were supposed to produce conduct only through the intermediation of this superior agent. Until they twitched its coat-tails, so to speak, no outward behavior could occur. This doctrine was long ago exploded by the discovery of the phenomena of reflex action, in which sensible impressions, as you know, produce movement immediately and of themselves.—JAMES *Talks to Teachers*, ch. 15, p. 170. (H. H. & Co., 1900.)

1077. ——— ——— *Volcanic Confused with Sedimentary Rocks.*—Thus on the shore near Portrush, in the North of Ireland, and in the skerries which lie off that coast, there occur great rock-masses, some of which undoubtedly agree with basalt in all their characters, while others are dark colored and crystalline, and are frequently crowded with *Ammonites* and other fossils. We now know that the explanation of these facts is as follows: Near where the town of Portrush is now situated, a volcanic vent was opened in Miocene times through rocks of Lias shale. From this igneous center, sheets and dikes of basaltic lava were given off, and in consequence of their contact with these masses of lava, the Lias shales were baked and altered, and assumed a crystalline character, tho the traces of the fossils contained in them were not altogether obliterated. In the last century the methods which had been devised for the discrimination of rocks were so imperfect that no distinction was recognized between the true basalt and the altered shale, and specimens of the latter containing *Ammonites* found their way to almost every museum in Europe, and were used as illustrations of the "origin of basalt by aqueous precipitation."—JUDD *Volcanoes*, ch. 9, p. 249. (A., 1899.)

1078. ——— ——— *Wild Conjecture of Sir John Herschel—Supposed Living Creatures on the Sun.*—We must remember how much there is unknown in the sun still, and what a great mystery even yet overhangs many of our relations to that body which maintains our own vital action, when we read the following words, which are [Sir John] Herschel's own. Speaking of these supposed spindle-shaped monsters [shown in certain drawings of the sun's surface], he says:

"The exceedingly definite shape of these objects, their exact similarity to one another, and the way in which they lie across and athwart each other—all these characters seem quite repugnant to the notion of their being of a vaporous, a cloudy, or a fluid nature. Nothing remains but to consider them as separate and independent sheets, flakes, or scales, having some sort of solidity. And these . . . are evidently the immediate sources of the solar light and heat, by whatever mechanism or whatever processes they may be enabled to develop, and as it were elaborate, these elements from the bosom of the non-luminous fluid in which they appear to float. Looked at in this point of view, we cannot refuse to regard them as organisms of some peculiar and amazing kind; and tho it would be too daring to speak of such organization as partaking of the nature of life, yet we do know that vital action is competent to develop at once heat and light and electricity."

Such are his words; and when we consider that each of these solar inhabitants was supposed to extend about two hundred by one thousand miles upon the surface of the fiery ocean, we may subscribe to Mr. Proctor's comment, that "Milton's picture of him who on the fires of hell 'lay floating many a rood,' seems tame and commonplace compared with Herschel's conception of these floating monsters, the least covering a greater space than the British Islands."—LANGLEY *New Astronomy*, ch. 13, p. 14. (H. M. & Co., 1896.)

1079. ERUPTION OF MONTE NUOVO —*Fish Taken on Land—Birds Falling Dead.*—Sir William Hamilton has given us two original letters describing this eruption [by which Monte Nuovo was formed]. The first, by Falconi, dated 1538, contains the following passages: "It is now two years since there have been frequent earthquakes at Puzzuoli, Naples, and the neighboring parts. On the day and in the night before the eruption (of Monte Nuovo), about twenty shocks, great and small, were felt. The eruption began on the 29th of September, 1538. It was on a Sunday, about one o'clock in the night, when flames of fire were seen between the hot baths and Tripergola. In a short time the fire increased to such a degree that it burst open the earth in this place, and threw up so great a quantity of ashes and pumice-stones, mixed with water, as covered the whole country. The next morning (after the formation of Monte Nuovo) the poor inhabitants of Puzzuoli quitted their habitations in terror, covered with the muddy and black shower which continued the whole day in that country—flying from death, but with death painted in their countenances. Some with their children in their arms, some with sacks full of their goods; others leading an ass, loaded with their frightened family, towards Naples; others carrying quantities of birds, of various sorts, that had fallen dead at the beginning of the eruption; oth-

ers, again, with fish which they had found, and which were to be met with in plenty on the shore, the sea having left them dry for a considerable time. I accompanied Signor Moramaldo to behold the wonderful effects of the eruption. The sea had retired on the side of Baiæ, abandoning a considerable tract, and the shore appeared almost entirely dry, from the quantity of ashes and broken pumice-stones thrown up by the eruption. I saw two springs in the newly discovered ruins; one before the house that was the queen's, of hot and salt water," etc. —LYELL *Principles of Geology*, bk. ii, ch. 23, p. 367. (A., 1854.)

1080. ERUPTION OF VESUVIUS— —*Description by Pliny.*—The first symptom of the revival of the energies of this volcano [Vesuvius] was the occurrence of an earthquake in the year 63 after Christ, which did considerable injury to the cities in its vicinity. From that time to the year 79 slight shocks were frequent; and in the month of August of that year they became numerous and violent, till they ended at length in an eruption. The elder Pliny, who commanded the Roman fleet, was then stationed at Misenum; and in his anxiety to obtain a near view of the phenomena, he lost his life, being suffocated by sulfurous vapors. His nephew, the younger Pliny, remained at Misenum, and has given us, in his "Letters," a lively description of the awful scene. A dense column of vapor was first seen rising vertically from Vesuvius, and then spreading itself out laterally, so that its upper portion resembled the head and its lower the trunk of the pine, which characterizes the Italian landscape. This black cloud was pierced occasionally by flashes of fire, as vivid as lightning, succeeded by darkness more profound than night. Ashes fell even upon the ships at Misenum, and caused a shoal in one part of the sea—the ground rocked, and the sea receded from the shores, so that many marine animals were seen on the dry sand. The appearances above described agree perfectly with those witnessed in more recent eruptions, especially those of Monte Nuovo, in 1538, and of Vesuvius in 1822.—LYELL *Principles of Geology*, bk. ii, ch. 23, p. 363. (A., 1854.)

1081. ——— ——— *Rain of Ashes—Darkness at Midday.*—Twenty-four hours after the fall of the cone of scoriæ [of Vesuvius, in the eruption of 1822], which was 426 feet high, and when the small but numerous streams of lava had flowed off, on the night between the 23d and 24th of October, there began a fiery eruption of ashes and rapilli, which continued uninterruptedly for twelve days, but was most violent during the first four days. During this period the explosions in the interior of the volcano were so loud that the mere vibrations of the air caused the ceilings to crack in the palace of Portici, altho no shocks of an earthquake were then or had previously been experienced. A remarkable phenomenon was observed in the neighboring villages of Resina, Torre del Greco, Torre del' Annunziata, and Bosche Tre Case. Here the atmosphere was so completely saturated with ashes that the whole region was enveloped in complete darkness during many hours in the middle of the day. The inhabitants were obliged to carry lanterns with them through the streets, as is often done in Quito during the eruptions of Pichincha. Never had the flight of the inhabitants been more general, for lava streams are less dreaded even than an eruption of ashes, a phenomenon unknown here in any degree of intensity, and one which fills the imaginations of men with images of terror from the vague tradition of the manner in which Herculaneum, Pompeii, and Stabiæ were destroyed.—HUMBOLDT *Views of Nature*, p. 365. (Bell, 1896.)

1082. ETERNITY, SUGGESTION OF —*Approach and Departure of a Comet—Whence and Whither—To Us a Journey of Perhaps Eight Million Years.*—A comet is seen in the far distant depths of space as a faint and scarcely discernible speck. It draws nearer and nearer with continually increasing velocity, growing continually larger and brighter. Faster and faster it rushes on, until it makes its nearest approach to our sun, and then, sweeping around him, it begins its long return voyage into infinite space. As it recedes it grows fainter and fainter, until at length it passes beyond the range of the most powerful telescopes made by man, and is seen no more. It has been seen for the first and last time by the generation of men to whom it has displayed its glories. It has been seen for the first and last time by the race of man itself. Nay more, according to the calculations made by astronomers, the comet has made its first and last visit to the solar system. Of all comets this cannot, indeed, be affirmed: but there are some whose motions will bear no other interpretation.

Whence came the comet? Trace back its path, and we find no place from which it could have started on its course until we consider the stars in the region of the heavens whence the comet appeared to travel. It would be idle to select any star in particular in that region as probably marking the spot whence the comet started. But suppose we take the brightest, some leading orb, lying at a distance not absolutely unmeasurable by man; suppose even that the course of that comet as it approached was such that it might have come from the star Alpha Centauri, which, so far as is known, is the nearest of all in the heavens; then, at a moderate computation, the journey from the neighborhood of that star has not occupied less than eight million years.—PROCTOR *Expanse of Heaven*, p. 134. (L. G. & Co., 1897.)

1083. ETHER PERVADES ALL BODIES—*Transparency to Different Colors—Union of Transparent Substances Producing Darkness.*—The luminiferous ether fills stellar space; it makes the universe a whole, and renders possible the intercommunication of light and energy between star and star. But the subtle substance penetrates farther; it surrounds the very atoms of solid and liquid substances. Transparent bodies are those which are so related to the ether that the waves of light can pass through them without transference of motion to their atoms. In colored bodies, certain waves are absorbed; but those which give the body its color pass without absorption. Through a solution of sulfate of copper, for example, the blue waves speed unimpeded, while the red waves are destroyed. When a luminous beam is sent through this solution, the red end of its spectrum is cut away. Red glass, on the contrary, owes its color to the fact that its substance can be traversed freely by the longer undulations of red, while the shorter waves are absorbed. Placed in the path of the light, it leaves merely a vivid red band upon the screen. The blue liquid, then, cuts off the rays transmitted by the red glass; and the red glass cuts off those transmitted by the liquid; by the union of both we ought to have perfect opacity, and so we have. When both are placed in the path of the beam, the entire spectrum disappears; the union of the two partially transparent bodies producing an opacity equal to that of pitch or metal.—TYNDALL *Heat a Mode of Motion*, lect. 11, p. 304. (A., 1900.)

1084. ETHER PERVADING SPACE A DOCTRINE OF ANCIENT PHILOSOPHY—*Held by Ionic Philosophers To Be Self-luminous.*—In the dogmas of the Ionic philosophy of Anaxagoras and Empedocles, this ether differed wholly from the actual (denser) vapor-charged air which surrounds the earth, and "probably extends as far as the moon." It was of "a fiery nature, a brightly beaming, pure fire-air, of great subtlety and eternal serenity."

Considered as a medium filling the regions of space, the ether of Empedocles presents no other analogies excepting those of subtlety and tenuity with the ether, by whose transverse vibrations modern physicists have succeeded so happily in explaining, on purely mathematical principles, the propagation of light, with all its properties of double refraction, polarization, and interference. The natural philosophy of Aristotle further teaches that the ethereal substance penetrates all the living organisms of the earth —both plants and animals; that it becomes in these the principle of vital heat, the very germ of a psychical principle, which, uninfluenced by the body, stimulates men to independent activity. These visionary opinions draw down ether from the higher regions of space to the terrestrial sphere, and represent it as a highly rarefied substance constantly penetrating through the atmosphere and through solid bodies; precisely similar to the vibrating light-ether of Huygens, Hooke, and modern physicists. But what especially distinguishes the older Ionic from the modern hypothesis of ether is the original assumption of luminosity, a view, however, not entirely advocated by Aristotle. The upper fire-air of Empedocles is expressly termed brightly radiating and is said to be seen by the inhabitants of the earth in certain phenomena, gleaming brightly through fissures and chasms which occur in the firmament.—HUMBOLDT *Cosmos*, vol. iii, p. 32. (H., 1897.)

1085. ETHICS UNIVERSALLY ASSOCIATED WITH RELIGION—*Religion an Everlasting Reality.*—Universally since that [primeval] time the notion of ethics has been inseparably associated with the notion of religion, and the sanction for ethics has been held to be closely related with the world beyond phenomena. There are philosophers who maintain that with the further progress of enlightenment this close relation will cease to be asserted, that ethics will be divorced from religion, and that the groping of the human soul after its God will be condemned as a mere survival from the errors of primitive savagery, a vain and idle reaching out toward a world of mere phantoms. I mention this opinion merely to express unqualified and total dissent from it. I believe it can be shown that one of the strongest implications of the doctrine of evolution is the everlasting reality of religion.—FISKE *Through Nature to God*, pt. ii, ch. 9, p. 110. (H. M. & Co., 1900.)

1086. EVIDENCE MULTIPLIES FOR WILLING MINDS—*Fall of Meteorites in France Attested by Academicians—Then Abundant Instances the World Over.*—Stories of falling stones, then, kept arising from time to time during the last century as they had always done, and philosophers kept on disbelieving them as they had always done, till an event occurred which suddenly changed scientific opinion to compulsory belief.

On the 26th of April, 1803, there fell, not in some far-off part of the world, but in France, not one alone, but many thousand stones, over an area of some miles, accompanied with noises like the discharge of artillery. A committee of scientific men visited the spot on the part of the French Institute, and brought back not only the testimony of scores of witnesses or auditors, but the stones themselves. Soon after stones fell in Connecticut, and here and elsewhere, as soon as men were prepared to believe, they found evidence multiplied: and such falls, it is now admitted, tho rare in any single district, are of what may be called frequent occurrence as regards the world at large—for, taking land and sea together, the annual stone-falls are probably to be counted by hundreds.—LANGLEY *New Astronomy*, ch. 6, p. 186. (H. M. & Co., 1896.)

1087. EVIDENCE OF PHOSPHORESCENCE IN DEEP-SEA ANIMALS—The subject of the power of emitting phosphorescent light possessed by some deep-sea animals is much more difficult to deal with.

The presence of distinct organs in many of the deep-sea fish that can only be reasonably interpreted as phosphorescent organs, the presence of well-developed and evidently functional eyes in many deep-sea animals, and many other considerations render it very highly probable that some, if not many, forms emit a phosphorescent light.

The power and constancy of the light emitted, however, must for the present remain a matter of conjecture.—HICKSON *Fauna of the Deep Sea*, ch. 4, p. 75. (A., 1894.)

1088. EVIDENCE OF SELF-DETERMINING POWER — *Common-sense Proof of External World.*—The writer entirely agrees with Archbishop Manning, in maintaining that we have exactly the same evidence of the existence of this self-determining power within ourselves, that we have of the existence of a material world outside ourselves. For however intimate may be the functional correlation between mind and brain—and Archbishop Manning seems disposed to go as far as the writer in recognizing this intimacy—"there is still another faculty, and more than this, another agent, distinct from the thinking brain." . . . "That we are conscious of thought and will, is a fact of our internal experience. It is a fact also of the universal experience of all men; this is an immediate and intuitive truth of absolute certainty. Dr. Carpenter lays down as an axiomatic truth 'that the common-sense decision of mankind, in regard to the existence of an external world, is practically worth more than all the arguments of all the logicians who have discussed the basis of our belief in it.'"—CARPENTER *Mental Physiology*, bk. i, ch. 1, p. 5. (A., 1900.)

1089. EVIDENCE THAT CHALK IS AN ANCIENT SEA-BOTTOM—The evidence furnished by the hewing, facing, and superposition of the stones of the pyramids, that these structures were built by men, has no greater weight than the evidence that the chalk was built by *Globigerinæ;* and the belief that those ancient pyramid-builders were terrestrial and air-breathing creatures, like ourselves, is not better based than the conviction that the chalk-makers lived in the sea. But as our belief in the building of the pyramids by men is not only grounded on the internal evidence afforded by these structures, but gathers strength from multitudinous collateral proofs, and is clinched by the total absence of any reason for a contrary belief; so the evidence drawn from the *Globigerinæ*, that the chalk is an ancient sea-bottom, is fortified by innumerable independent lines of evidence; and our belief in the truth of the conclusion to which all positive testimony tends, receives the like negative justification from the fact that no other hypothesis has a shadow of foundation.—HUXLEY *Lay Sermons*, serm. 9, p. 187. (G. P. P., 1897.)

1090. EVIDENCE, UNTRUSTWORTHY—*Excitement, Credulity, and Inaccuracy May Vitiate.*—But, in dealing with the descriptions of these grand and terrible events, we must always be on our guard against accepting as literal facts the statements made by witnesses, often writing at some distance from the scene of action, and almost always under the influence of violent excitement and terror. The desire to administer to the universal love of the marvelous, and the tendency to exaggeration, will usually account for many of the wonderful statements contained in such records; and, even where the witness is accurately relating events which he thinks passed before his eyes, we must remember that it is probable he may have had neither the opportunity nor the capacity for exact observation.—JUDD *Volcanoes*, ch. 2, p. 30. (A., 1899.)

1091. EVIL DESTROYED BY GROWTH OF GOOD—*Scientific Control of Bacteria—Favorable Germs Planted to Exterminate the Undesirable.*—Recently, however, a new method has been introduced, largely through the work and influence of Professor Storch in Denmark, which is based upon our new knowledge respecting bacterial action in cream-ripening. We refer to the artificial processes of ripening set up by the addition of pure cultures of favorable germs. If a culture of organisms possessing the faculty of producing in cream a good flavor be added to the sweet cream, it is clear that advantage will accrue. This simple plan of starting any special or desired flavor by introducing the specific micro-organisms of that flavor may be adopted in two or three different ways. If cream be inoculated with a large, pure culture of some particular kind of bacteria, this species will frequently grow so well and so rapidly that it will check the growth of the other bacteria which were present in the cream at the commencement and before the starter was added. That is, perhaps, the simplest method of adding an artificial culture.—NEWMAN *Bacteria*, ch. 6, p. 217. (G. P. P., 1899.)

1092. EVIL, MORAL, A UNIVERSAL FACT—*Unworthiness Distinct from Ignorance.*—There is an absolute contrast between our sense of limitation in respect to intellectual power (or knowledge) and our sense of unworthiness in respect to moral character. It is not of ignorance, but of knowledge, that we are conscious here—even the knowledge of the distinction between good and evil, and of that special sense which in our nature is associated with it, namely, the sense of moral obligation. Now it is a universal fact of consciousness as regards ourselves, and of observation in regard to others, that, knowing evil to be evil, men are nevertheless

prone to do it, and that, having this sense of moral obligation, they are nevertheless prone to disobey it. This fact is entirely independent of the particular standard by which men in different stages of society have judged certain things to be good and other things to be evil. It is entirely independent of the infinite variety of rules according to which they recognize the doing of particular acts, and the abstention from other acts, to be obligatory upon them. Under every variety of circumstance in regard to these rules, under every diversity of custom, of law, or of religion by which they are stablished, the general fact remains the same—that what men themselves recognize as duty they continually disobey, and what according to their own standard they acknowledge to be wrong they continually do. —ARGYLL *Unity of Nature*, ch. 9, p. 190. (Burt.)

1093. EVIL OVERCOME BY GOOD —*Inhibition by Substitution—Love of Right the Highest Victory (Jer. xxxi, 33).*—It is clear that in general we ought, whenever we can, to employ the method of inhibition by substitution. He whose life is based upon the word "no," who tells the truth because a lie is wicked, and who has constantly to grapple with his envious and cowardly and mean propensities, is in an inferior situation in every respect to what he would be if the love of truth and magnanimity positively possessed him from the outset, and he felt no inferior temptations.—JAMES *Talks to Teachers*, ch. 15, p. 194. (H. H. & Co., 1900.)

1094. EVOLUTION A GENERAL LAW —*Recognized in Diverse Realms of Being.*—The interpretation of phenomena as results of evolution has been independently showing itself in various fields of inquiry, quite remote from one another. The supposition that the solar system has been evolved out of diffused matter is a supposition wholly astronomical in its origin and application. Geologists, without being led thereto by astronomical considerations, have been step by step advancing towards the conviction that the earth has reached its present varied structure by modification upon modification. The inquiries of biologists have proved the falsity of the once general belief, that the germ of each organism is a minute repetition of the mature organism, differing from it only in bulk; and they have shown, contrariwise, that every organism advances from simplicity to complexity through insensible changes. Among philosophical politicians there has been spreading the perception that the progress of society is an evolution: the truth that "constitutions are not made, but grow," is seen to be a part of the more general truth that societies are not made, but grow. It is now universally admitted by philologists that languages, instead of being artificially or supernaturally formed, have been developed. And the histories of religion, of science, of the fine arts, of the industrial arts, show that these have passed through stages as unobtrusive as those through which the mind of a child passes on its way to maturity.—SPENCER *Biology*, pt. iii, ch. 3, p. 432. (A., 1900.)

1095. EVOLUTION A STUDY FOR THE NURSERY—*Every Mother an Unconscious Evolutionist—The Evolution of Man Read in the Mind of a Little Child.*—The most beautiful witness to the evolution of man is the mind of a little child. The stealing in of that inexplicable light—yet not more light than sound or touch—called consciousness, the first flicker of memory, the gradual governance of will, the silent ascendancy of reason—these are studies in evolution the oldest, the sweetest, and the most full of meaning for mankind. Evolution, after all, is a study for the nursery. It was ages before Darwin or Lamarck or Lucretius that maternity, bending over the hollowed cradle in the forest for a first smile of recognition from her babe, expressed the earliest trust in the doctrine of development. Every mother since then is an unconscious evolutionist, and every little child a living witness to ascent.—DRUMMOND *Ascent of Man*, ch. 4, p. 119. (J. P., 1900.)

1096. EVOLUTION CHANGES ITS COURSE—*From a Physical to a Psychical Universe.*—Once it was a physical universe, now it is a psychical universe. And to say that the working of evolution has changed its course, and set its compass in psychical directions, is to call attention to the most remarkable fact in Nature. Nothing so original or so revolutionary has ever been given to science to discover, to ponder, or to proclaim. The power of this event to strike and rouse the mind will depend upon one's sense of what the working of evolution has been to the world; but those who realize this even dimly will see that no emphasis of language can exaggerate its significance.—DRUMMOND *Ascent of Man*, ch. 3, p. 117. (J. P., 1900.)

1097. EVOLUTION CONSISTENT WITH CREATION—But of this we may be sure, that if men should indeed ultimately become convinced that species have been all born just as individuals are now all born, and that such has been the universal method of creation, this conviction will not only be found to be soluble, so to speak, in the old beliefs respecting a creative mind, but it will be unintelligible and inconceivable without them, so that men, in describing the history and aim and direction of evolution, will be compelled to use substantially the same language in which they have hitherto spoken of the history of creation.—ARGYLL *Unity of Nature*, ch. 8, p. 173. (Burt.)

1098. EVOLUTION EXALTS HUMANITY—*Man the Last Victor of Ages of Struggle—The Fruit and Crown of a Past Eternity.*—Science is charged, be it once

more recalled, with numbering man among the beasts, and leveling his body with the dust. But he who reads for himself the history of creation as it is written by the hand of evolution will be overwhelmed by the glory and honor heaped upon this creature. To be a man, and to have no conceivable successor; to be the fruit and crown of the long past eternity, and the highest possible fruit and crown: to be the last victor among the decimated phalanxes of earlier existences, and to be nevermore defeated; to be the best that Nature in her strength and opulence can produce; to be the first of that new order of beings who, by their dominion over the lower world and their equipment for a higher, reveal that they are made in the image of God—to be this is to be elevated to a rank in Nature more exalted than any philosophy or any poetry or any theology has ever given to man.—DRUMMOND *Ascent of Man*, ch. 3, p. 115. (J. P., 1900.)

1099. EVOLUTION INTERPRETED AS BLANK MATERIALISM—Modern scientific thought is called upon to decide between this hypothesis [of evolution] and another; and public thought generally will afterwards be called upon to do the same. But, however the convictions of individuals here and there may be influenced, the process must be slow and secular which commends the hypothesis of natural evolution to the public mind. For what are the core and essence of this hypothesis? Strip it naked, and you stand face to face with the notion that not alone the more ignoble forms of animalcular or animal life, not alone the nobler forms of the horse and lion, not alone the exquisite and wonderful mechanism of the human body, but that the human mind itself—emotion, intellect, will, and all their phenomena—were once latent in a fiery cloud. Surely the mere statement of such a notion is more than a refutation. But the hypothesis would probably go even farther than this. Many who hold it would probably assent to the position that, at the present moment, all our philosophy, all our poetry, all our science, and all our art—Plato, Shakespeare, Newton, and Raphael—are potential in the fires of the sun. We long to learn something of our origin. If the evolution hypothesis be correct, even this unsatisfied yearning must have come to us across the ages which separate the primeval mist from the consciousness of to-day. I do not think that any holder of the evolution hypothesis would say that I overrate or overstrain it in any way. I merely strip it of all vagueness, and bring before you, unclothed and unvarnished, the notions by which it must stand or fall.—TYNDALL *Fragments of Science*, vol. ii. ch. 8, p. 130. (A., 1897.)

1100. EVOLUTION INVOLVES MORE THAN NATURAL SELECTION—*Morality Rooted in the Foundations of the Universe.*—In such a universe [controlled solely by the struggle for life and survival of the fittest] we may look in vain for any sanction for morality, any justification for love and self-sacrifice; we find no hope in it, no consolation; there is not even dignity in it, nothing whatever but resistless all-producing and all-consuming energy. Such a universe, however, is not the one in which we live. In the cosmic process of evolution, whereof our individual lives are part and parcel, there are other agencies at work besides natural selection, and the story of the struggle for existence is far from being the whole story. I think it can be shown that the principles of morality have their roots in the deepest foundations of the universe, that the cosmic process is ethical in the profoundest sense, that in that far-off morning of the world when the stars sang together and the sons of God shouted for joy, the beauty of self-sacrifice and disinterested love formed the chief burden of the mighty theme.—FISKE *Through Nature to God*, pt. ii, ch. 4, p. 78. (H. M. & Co., 1900.)

1101. EVOLUTION, MAN KNOWS THAT IT IS A PROCESS—*Intelligently Co-operates with It.*—Man differs from every other product of the evolutionary process in being able to see that it is a process, in sharing and rejoicing in its unity, and in voluntarily working through the process himself. If he is part of it he is also more than part of it, since he is at once its spectator, its director, and its critic.—DRUMMOND *Ascent of Man*, p. 12. (J. P., 1900.)

1102. EVOLUTION, MATERIALISTIC—*A Pillar without a Capital—A Process without a Purpose—Christianity Supplies the Goal.*—Hitherto evolution had no future. It was a pillar with marvelous carving, growing richer and finer towards the top, but without a capital; a pyramid, the vast base buried in the inorganic, towering higher and higher, tier above tier, life above life, mind above mind, ever more perfect in its workmanship, more noble in its symmetry, and yet withal so much the more mysterious in its aspiration. The most curious eye, following it upwards, saw nothing. The cloud fell and covered it. Just what men wanted to see was hid. The work of the ages had no apex. But the work begun by Nature is finished by the Supernatural — as we are wont to call the higher natural. And as the veil is lifted by Christianity it strikes men dumb with wonder. For the goal of evolution is Jesus Christ.—DRUMMOND *Natural Law in the Spiritual World*, essay 8, p. 280. (H. Al.)

1103. EVOLUTION NOT ACCOUNTED FOR—To give an account of evolution, it need scarcely be remarked, is not to account for it. No living thinker has yet found it possible to account for evolution.—DRUMMOND *Ascent of Man*, int., p. 4. (J. P., 1900.)

1104. EVOLUTION NOT ATHEISTIC *—Design Not Superseded—Place of Second Causes.*—To myself the conception of a continuity of action which required no departure to meet special contingencies, because the plan was all-perfect in the beginning, is a far higher and nobler one than that of a succession of interruptions, such as would be involved in the creation *de novo* of the vast series of new types which paleontological study is daily bringing to our knowledge. And in describing the process of evolution in the ordinary language of science, as due to "secondary causes," we no more dispense with a First Cause than we do when we speak of those physical forces which, from the theistic point of view, are so many diverse modes of manifestation of one and the same power. Nor do we in the least set aside the idea of an original design when we regard these adaptations, which are commonly attributed to special exertions of contriving power and wisdom, as the outcome of an all-comprehensive intelligence which foresaw that the product would be "good," before calling into existence the germ from which it would be evolved. We simply, to use the language of Whewell, "transfer the notion of design and end from the region of facts to that of laws," that is, from the particular cases to the general plan: and find ourselves aided in our conception of the infinity of creative wisdom and power, when we regard it as exerted in a manner which shows that not only the peopling of the globe with the plants and animals suited to every phase of its physical conditions, but the final production of man himself—the heir of all preceding ages, with capacities that enable him to become but "a little lower than the angels"—was comprehended in the original scheme.—CARPENTER *Nature and Man,* lect. 14, p. 407. (A., 1889.)

1105. EVOLUTION OF EARTH'S CRUST—*Theory of Catastrophe Abandoned—Past Flows Gradually into Present.*—With increased knowledge . . . it was recognized that no hard-and-fast line separates past and present. The belief in world-wide, or nearly world-wide, catastrophes disappeared. Geologists came to see that the fashioning of the earth's surface had been going on for a long time, and is still in progress. The law of evolution, they have found, holds true for the crust of the globe just as it does for the myriad tribes of plants and animals that clothe and people it. It is no longer doubted that the existing configuration of the land has resulted from the action of forces that are still in operation, and by observation and reasoning the history of the various phases in the evolution of surface-features can be unfolded.—GEIKIE *Earth Sculpture,* ch. 1, p. 2. (G. P. P., 1898.)

1106. EVOLUTION OF EVIL—*The Law of Degeneracy—Double Aspect of Development.*—It is a curious misunderstanding of what that law [of evolution] really is to suppose that it leads only in one direction. It leads in every direction in which there is at work any one of the "potential energies" of Nature. Development is the growth of germs, and according to the nature of the germ so is the nature of the growth. The flowers and fruits which minister to the use of man have each their own seed, and so have the briers and thorns which choke them. Evil has its germs as well as good, and the evolution of them is accompanied by effects to which it is impossible to assign a limit. Movement is the condition of all being, in moral as well as in material things. Just as one thing leads to another in knowledge and in virtue, so does one thing lead to another in ignorance and vice. Those gradual processes of change which arise out of action and reaction between the external condition and the internal nature of man have an energy in them of infinite complexity and power. We stand here on the firm ground of observation and experience. In the shortest space of time, far within the limits even of a single life, we are accustomed to see such processes effectual both to elevate and degrade. The weak become weaker and the bad become worse. "To him that hath more is given, and from him that hath not is taken even that which he seemeth to have." And this law, in the region of character and of morals, is but the counterpart of the law which prevails in the physical regions of Nature, where also development has its double aspect. It cannot bring one organism to the top without sinking another organism to the bottom. That vast variety of natural causes which have been grouped and almost personified under the phrase "natural selection" are causes which necessarily include both favorable and unfavorable conditions. Natural rejection, therefore, is the inseparable correlative of natural selection.—ARGYLL *Unity of Nature,* ch. 10, p. 230. (Burt.)

1107. EVOLUTION OF EVOLUTION *—By Its Very Nature a System of Progress.* —This is the age of the evolution of evolution. All thoughts that the evolutionist works with, all theories and generalizations, have been themselves evolved and are now being evolved. Even were his theory perfected, its first lesson would be that it was itself but a phase of the evolution of further opinion, no more fixed than a species, no more final than the theory which it displaced. Of all men the evolutionist, by the very nature of his calling, the mere tools of his craft, his understanding of his hourly shifting-place in this always moving and ever more mysterious world, must be humble, tolerant, and undogmatic.—DRUMMOND *Ascent of Man,* int., p. 7. (J. P., 1900.)

1108. EVOLUTION OF LANGUAGE TAUGHT BY COMPARATIVE PHILOLOGY—*Renan — Max Müller — Languages Seen in the Making.*—Comparative philology

has now made an actual investigation into the words and structure of all known languages, and the information sought by the evolutionist lies ready-made to his hand. So far as controversy might be expected to arise here on the theory of development itself, there is none. For the first fact to interest us in this new region is that every student of language seems to have been compelled to give in his adherence to the general theory of evolution. All agree with Renan that "Sans doubte les langues, comme tout ce qui est organisé, sont sujettes à la loi du développement graduel" [without doubt languages, like all that is organized, are subject to the law of gradual development]. And even Max Müller, the least thorough-going from an evolutionary point of view of all philologists, asserts that "no student of the science of language can be anything but an evolutionist, for, wherever he looks, he sees nothing but evolution going on all around him."—DRUMMOND *Ascent of Man*, ch. 5, p. 179. (J. P., 1900.)

1109. EVOLUTION OF PHOSPHORESCENT ORGANS—*Gradation Manifest in Marine Animals.*—It has been known for some years now that the slime secreted by the skin-glands of certain sharks is highly phosphorescent. It is not difficult, then, to understand how it came about that certain fish developed complicated phosphorescent organs.

From the phosphorescent slime secreted by a simple skin-gland to the most complicated eyelike phosphorescent organ, we have a series of intermediate forms that are quite sufficient, even in the imperfect state of our knowledge at the present day, to enable us to understand the outlines of the evolution of these peculiar and interesting organs.—HICKSON *Fauna of the Deep Sea*, ch. 4, p. 77. (A., 1894.)

1110. EVOLUTION OF SCIENCES—*Mind in Relation to Environment.*—At a certain stage in the development of every science a degree of vagueness is what best consists with fertility. On the whole, few recent formulas have done more real service of a rough sort in psychology than the Spencerian one that the essence of mental life and of bodily life are one, namely, "the adjustment of inner to outer relations." Such a formula is vagueness incarnate; but because it takes into account the fact that minds inhabit environments which act on them and on which they in turn react; because, in short, it takes mind in the midst of all its concrete relations, it is immensely more fertile than the old-fashioned "rational psychology," which treated the soul as a detached existent, sufficient unto itself, and assumed to consider only its nature and properties.—JAMES *Psychology*, vol. i, ch. 1, p. 6. (H. H. & Co., 1899.)

1111. EVOLUTION OUT OF FOCUS—*Must Sweep in Whole Truth.*—Evolution was given to the modern world out of focus, was first seen by it out of focus, and has remained out of focus to the present hour. Its general basis has never been reexamined since the time of Mr. Darwin; and not only such speculative sciences as teleology, but working sciences like sociology, have been led astray by a fundamental omission. An evolution theory drawn to scale, and with the lights and shadows properly adjusted—adjusted to the whole truth and reality of Nature and of man—is needed at present as a standard for modern thought.—DRUMMOND *Ascent of Man*, int., p. 6. (J. P., 1900.)

1112. EXACTNESS, NERVELESS, OF THE PHOTOGRAPH—*Nervous Tension May Disqualify the Human Observer.*—To the equatorial telescopes photographic cameras are attached instead of the eyepieces, in the hope that the corona may be made to impress itself on the plate instead of on the eye. The eye is an admirable instrument itself, no doubt; but behind it is a brain, perhaps overwrought with excitement, and responding too completely to the nervous tension which most of us experience when those critical moments are passing so rapidly. The camera can see far less of the corona than the man, but it has no nerves, and what it sets down we may rely on.—LANGLEY *New Astronomy*, ch. 2, p. 47. (H. M. & Co., 1896.)

1113. EXACTNESS OF SCIENCE—*Astronomy Depends upon Hairbreadths and Fractions of a Second.*—Such are the refinements upon which modern astronomy depends for its progress. It is a science of hairbreadths and fractions of a second. It exists only by the rigid enforcement of arduous accuracy and unwearying diligence. Whatever secrets the universe still has in store for man will only be communicated on these terms. They are, it must be acknowledged, difficult to comply with. They involve an unceasing struggle against the infirmities of his nature and the instabilities of his position. But the end is not unworthy the sacrifices demanded. One additional ray of light thrown on the marvels of creation—a single, minutest encroachment upon the strongholds of ignorance—is recompense enough for a lifetime of toil. Or rather, the toil is its own reward, if pursued in the lofty spirit which alone becomes it. For it leads through the abysses of space and the unending vistas of time to the very threshold of that infinity and eternity of which the disclosure is reserved for a life to come.—CLERKE *History of Astronomy*, pt. i, ch. 6, p. 153. (Bl., 1893.)

1114. ——— ——— *Difficulty of Securing a Sample of Water—Infinitesimal Pollution Will Spoil All Results.*—The collection of samples [of water], tho it appears simple enough, is sometimes a difficult and responsible undertaking. Complicated ap-

paratus is rarely necessary, and fallacies will generally be avoided by observing two directions. In the first place, the sample should be chosen as representative as possible of the real substance or conditions we wish to examine. Some authorities advise that it is necessary to allow the tap to run for some minutes previous to collecting the sample; but if we desire to examine for lead chemically or for micro-organisms in the pipes biologically, then such a proceeding would be injudicious. Hence we must use common sense in the selection and obtaining of a sample, following this one guide, namely, to collect as nearly as possible a sample of the exact water the quality of which it is desired to learn. In the second place, we must observe strict bacteriological cleanliness in all our manipulations. This means that we must use only sterilized vessels or flasks for collecting the sample, and in the manipulation required we must be extremely careful to avoid any pollution of air or any addition to the organisms of the water from unsterilized apparatus. A flask polluted in only the most infinitesimal degree will entirely vitiate all results.—NEWMAN *Bacteria*, ch. 2, p. 37. (G. P. P., 1899.)

1115. ——— ——— *Disregarded by Popular Writers.*—Hitherto the endeavor of assigning these levels [of animal intelligence] has been almost exclusively in the hands of popular writers; and as these have, for the most part, merely strung together, with discrimination more or less inadequate, innumerable anecdotes of the display of animal intelligence, their books are valueless as works of reference. So much, indeed, is this the case that comparative psychology has been virtually excluded from the hierarchy of the sciences. If we except the methodical researches of a few distinguished naturalists, it would appear that the phenomena of mind in animals, having constituted so much and so long the theme of unscientific authors, are now considered well-nigh unworthy of serious treatment by scientific methods.—ROMANES *Animal Intelligence*, pref., p. 6. (A., 1899.)

1116. ——— ——— *Early Disinfecting Processes Conspicuously Inexact—Working without a Standard.*—The effects of chemical substances as solutions, or in spray form, upon bacteria have been observed from the earliest days of bacteriology. To some decomposing matter or solution a disinfectant was added and subcultures made. If bacteria continued to develop, the disinfection had not been efficient; if, on the other hand, the subculture remained sterile, disinfection had been complete. From such rough-and-ready methods large deductions were drawn, and it is hardly too much to say that no branch of bacteriology contains such a vast mass of unassimilated and unassimilable statements as that relating to research into disinfectants. Most of the tabulated and recorded results are conspicuous in having no standard as regards bacterial growth. Yet without such a standard results are not comparable.—NEWMAN *Bacteria*, ch. 9, p. 329. (G. P. P., 1899.)

1117. ——— ——— *Influence of Height upon Combustion—Ghostly Flame on Summit of Mont Blanc.*—To determine the influence of height upon the rate of combustion was one of the problems which I set before myself in my journey to the Alps in 1859. On that occasion I invited Dr. Frankland to accompany me, and to undertake the experiments on combustion, while I devoted myself to observations on solar radiation. The plan pursued was this: six candles were purchased at Chamouni and carefully weighed; they were then allowed to burn for an hour in the Hôtel de l'Union, and the loss of weight was determined. The same candles were taken to the summit of Mont Blanc, and, on the morning of August 21, 1859, were allowed to burn for an hour in a tent, which shaded them from the sun and sheltered them from the wind. The aspect of the six flames at the summit surprised us both. They seemed the mere ghosts of the flames produced at Chamouni—enlarged, pale, feeble, and suggesting a greatly diminished energy of combustion. The candles being carefully weighed on our return, the unexpected fact was revealed that the quantity of stearin consumed above was almost precisely the same as that consumed below. Thus, tho the light-giving power of the flame was diminished in an extraordinary degree, the rapidity of the combustion was unchanged. This curious result is to be ascribed mainly to the mobility of the air at this great height. The particles of oxygen could penetrate the flame with comparative freedom, thus destroying its light, and making atonement for the smallness of their number by the rapidity of their action. I find, indeed, that by reducing the density of ordinary atmospheric air to one-half, we nearly double the mobility of its atoms.—TYNDALL *Heat a Mode of Motion*, lect. 3, p. 64. (A., 1900.)

1118. ——— ——— *Light as an Indicator of Motion—The Faintest Thrills of Heat or Magnetism Measured.*—Now, this law of angular reflection [the law, viz.: that *when a mirror rotates, the angular velocity of a beam reflected from it is twice that of the reflecting mirror*], coupled with the fact that a beam of light possesses no weight, gives us the means of magnifying small motions to an extraordinary degree. Thus, by attaching mirrors to his suspended magnets, and by watching the images of divided scales reflected from the mirrors, the celebrated Gauss was able to detect the slightest thrill of variation on the part of the earth's magnetic force. By a similar arrangement the feeble attractions and repulsions of the diamagnetic force have been made manifest. The minute elongation of a bar of metal by the mere warmth of the

hand may be so magnified by this method as to cause the index-beam to move through 20 or 30 feet. The lengthening of a bar of iron when it is magnetized may be also thus demonstrated.—TYNDALL *Lectures on Light,* lect. 1, p. 12. (A., 1898.)

1119. ——— ——— *Lines of the Spectrum Made to Tell Their Story—Minerals in the Sun—Helium Found on Earth.*—It was already known that the various chemical elements, when heated to incandescence, produce spectra consisting of a group of colored bands, and it had been noticed that some of these bands, as the yellow band of sodium, corresponded in position with certain black lines in the solar spectrum. Kirchoff's discovery consisted in showing that, when the light from an incandescent body passes through the same substance in a state of vapor, much of it is absorbed, and the colored bands become replaced by black lines. The black lines in the solar spectrum are due, on this theory, to the light from the incandescent body of the sun being partially absorbed in passing through the vapors which surround it. This theory led to a careful examination of the spectra of all the known elements, and on comparing them with the solar spectrum it was found that in many cases the colored bands of the elements corresponded exactly in position with certain groups of black lines in the solar spectrum. Thus hydrogen, sodium, iron, magnesium, copper, zinc, calcium, and many other elements have been proved to exist in the sun. Some outstanding solar lines, which did not correspond to any known terrestrial element, were supposed to indicate an element peculiar to the sun, which was therefore named helium. Quite recently this element has been discovered in a rare mineral, and its colored spectrum is found to correspond exactly to the dark lines in the solar spectrum on which it was founded, thus adding a final proof of the correctness of the theory, and affording a striking example of its value as an instrument of research.—WALLACE *The Wonderful Century,* ch. 6, p. 43. (D. M. & Co., 1899.)

1120. ——— ——— *Measurement of Vision—Light-intensities Measurable by Galvanic Current.*—It only remains for us in this case to determine the least light-intensity, which is in absolute darkness just noticeably brighter than the black of the field of vision. We can most easily obtain very weak light-intensities of this kind by passing a constant current through a metal wire. As we increase the intensity of the current, the wire becomes hotter and hotter, till at a definite temperature it begins to be luminous. And since we can graduate the strength of a galvanic current at our pleasure, the intensity at which the luminosity of the wire becomes just noticeable can be readily determined. We have then only to compare its objective value with that of other known light-intensities. It has been found in this way that the just noticeable intensity of light is approximately $\frac{1}{300}$ of the light of the full moon reflected from white paper.—WUNDT *Psychology,* lect. 4, p. 54. (Son. & Co., 1896.)

1121. ——— ——— *Measuring the Salmon's Leap.*—The distances up rivers to which salmon will swim in the spawning season is no less surprising than the energy with which they perform the feat, and the determination with which they overcome all obstacles. They reach Bohemia by the Elbe and Switzerland by the Rhine. On encountering a waterfall they display astonishing agility and perseverance in surmounting the obstacle. This fact, of course, is well known to all salmon-fishers; but the actual vertical height to which a well-grown salmon is able to leap has only recently (1886) been made the subject of exact measurement. By means of upright posts fixed upon the banks of a stream on either side of a waterfall in Norway, Professor Landmark has determined that this fish is able to rise through the air, by a single spring, a vertical distance of sixteen feet. The salmon, therefore, may be said to have no competitor in its performance of the high jump, unless it be the kangaroo, as to whose powers in this respect I have not been able to find trustworthy information.—ROMANES *Animal Intelligence,* ch. 8, p. 249. (A., 1899.)

1122. ——— ——— *Minute Displacement of Sirius—Still More Minute Correction.*—The annual displacement of Sirius may be thus illustrated: On a clear moonlight night let the reader notice the apparent diameter of the moon. Next let him try to conceive that diameter divided into about 3,800 equal parts. Then the greatest displacement of Sirius is equal to one of those minute portions. Sirius in fact appears to circle round a minute oval path on the heavens, having for its longest diameter a space equal to about the 3,800th part of the moon's apparent diameter. Now, the error of the earlier estimate (supposing that estimate erroneous) consisted in setting the displacement of Sirius at about the 6,300th part of the moon's diameter—the difference between the two estimates corresponding to about the 9,500th part of the moon's apparent diameter. If the reader will but conceive the moon's apparent diameter divided into about 100 parts, and one of these parts again into 100 parts, he will be able to form an idea of the exceeding minuteness of the quantity by which astronomers suppose that their first estimate was erroneous.—PROCTOR *Our Place among Infinities,* p. 166. (L. G. & Co., 1897.)

1123. ——— ——— *Newton Calculates the Depth of Fine Film of Air.*—Newton compared the tints obtained in this way [a plate of glass with a plane surface being laid on a plano-convex glass lens of very f. ble curvature] with the tints of his soap-

bubble, and he calculated the corresponding thickness. How he did this may be thus made plain to you: Suppose the water of the ocean to be absolutely smooth; it would then accurately represent the earth's curved surface. Let a perfectly horizontal plane touch the surface at any point. Knowing the earth's diameter, any engineer or mathematician in this room could tell you how far the sea's surface will lie below this plane, at the distance of a yard, ten yards, a hundred yards, or a thousand yards from the point of contact of the plane and the sea. It is common, indeed, in leveling operations, to allow for the curvature of the earth. Newton's calculation was precisely similar. His plane glass was a tangent to his curved one. From its refractive index and focal distance he determined the diameter of the sphere of which his curved glass formed a segment, he measured the distances of his rings from the place of contact, and he calculated the depth between the tangent plane and the curved surface exactly as the engineer would calculate the distance between his tangent plane and the surface of the sea. The wonder is that, where such infinitesimal distances are involved, Newton, with the means at his disposal, could have worked with such marvelous exactitude.—TYNDALL *Lectures on Light*, lect. 2, p. 74. (A., 1898.)

1124. ——— ——— *Pasteur's Care in Experiments—No Life in Glacier Air.*—The caution exercised by Pasteur, both in the execution of his experiments and in the reasoning based upon them, is perfectly evident to those who, through the practise of severe experimental inquiry, have rendered themselves competent to judge of good experimental work. He found germs in the mercury used to isolate his air. He was never sure that they did not cling to the instruments he employed, or to his own person. Thus when he opened his hermetically sealed flasks upon the Mer de Glace, he had his eye upon the file used to detach the drawn-out necks of his bottles, and he was careful to stand to leeward when each flask was opened. Using these precautions, he found the glacier air incompetent, in nineteen cases out of twenty, to generate life; while similar flasks, opened amid the vegetation of the lowlands, were soon crowded with living things.—TYNDALL *Floating Matter of the Air*, p. 33. (A., 1895.)

1125. ——— ——— *Precise Quantitative Measurements Needed—Refraction of Light—Kepler a Theorist on the Observations of Others—The "Personal Equation" in Science.*—As regards the refraction of light, the course of real inquiry was resumed in 1100 by an Arabian philosopher named Alhazen. Then it was taken up in succession by Roger Bacon, Vitellio, and Kepler. One of the most important occupations of science is the determination, by precise measurements, of the quantitative relations of phenomena; the value of such measurements depending greatly upon the skill and conscientiousness of the man who makes them. Vitellio appears to have been both skilful and conscientious, while Kepler's habit was to rummage through the observations of his predecessors, to look at them in all lights, and thus distil from them the principles which united them. He had done this with the astronomical measurements of Tycho Brahe, and had extracted from them the celebrated "laws of Kepler." He did it also with Vitellio's measurements of refraction. But in this case he was not successful. The principle, tho a simple one, escaped him, and it was first discovered by Willebrod Snell, about the year 1621.—TYNDALL *Lectures on Light*, lect. 1, p. 14. (A., 1898.)

1126. ——— ——— *Specimens Once Vaguely Located—Loose Methods Now Discarded.*—Fifty years ago the exact locality from which any animal came seemed an unimportant fact in its scientific history, for the bearing of this question on that of origin was not then perceived. To say that any specimen came from South America was quite enough; to specify that it came from Brazil, from the Amazons, the San Francisco, or the La Plata, seemed a marvelous accuracy in the observers. In the museum at Paris, for instance, there are many specimens entered as coming from New York or from Pará; but all that is absolutely known about them is that they were shipped from those seaports. Nobody knows exactly where they were collected. So there are specimens entered as coming from the Rio San Francisco, but it is by no means sure that they came exclusively from that water-basin. All this kind of investigation is far too loose for our present [1865] object.—AGASSIZ *Journey in Brazil*, ch. 1, p. 9. (H. M. & Co., 1896.)

1127. ——— ——— *Velocity of Light Determined.*—The velocity of light, as is well known, was first determined by irregularities in the time of the eclipses of Jupiter's satellites, which were found to occur earlier or later than the calculated times, according as we were near to or far from the planet. It was thus found that it required [about] eight minutes for light to travel from the sun to the earth, a distance of a little more than ninety millions of miles: so that light travels about 186,000 miles in a single second of time. It would seem at first sight impossible to measure the time taken by light in traveling a mile, yet means have been discovered to do this, and even to measure the time taken for light to traverse a few feet from one side of a room to the other. Yet more, this method of measuring the velocity of light has, by successive refinements, become so accurate that it is now considered to be the most satisfactory method of determining the mean distance of the sun from the earth, a distance

which serves as the unit of measurement for the solar system and the whole stellar universe.—WALLACE *The Wonderful Century*, ch. 8, p. 60. (D. M. & Co., 1899.)

1128. EXCESS OF CONCENTRATION —*Pure Waters Evaporated to Bitterness.*—The streams flowing to the [Great Salt] lake rise in the high mountains to the east and are clear and limpid, and of such purity that only chemical tests reveal the presence of the mineral matter they have dissolved from the rocks and soils. Several of these streams are truly rivers in volume, as well as in name, and send a never-ceasing flood to the lake. Their combined volumes average throughout the year about 10,000 cubic feet per second. . . . None of the springs supplying the lake, with a single known exception, of small volumes, are markedly saline. The salts they contain are acquired largely during the upward passage of the water through the sediment of former lakes; and their influence on the chemistry of the present lake is more important than in the case of any other lake in the same region. It is safe to conclude, however, that the combined volumes of the streams and springs now tributary to the lake, if not concentrated by evaporation, would form a water body in which no trace of saline matter would be apparent to the taste.—RUSSELL *Lakes of North America*, ch. 4, p. 80. (G. & Co., 1895.)

1129. EXCESS OF INCREASE TENDS TO EXTERMINATION—The tendency to multiply rapidly, so advantageous in normal seasons, becomes almost fatal to a species in seasons of exceptional abundance. Cover and food without limit enabled the mice to increase at such an amazing rate that the lesser checks interposed by predatory species were for a while inappreciable. But as the mice increased, so did their enemies. Insectivorous and other species acquired the habits of owls and weasels, preying exclusively on them; while to this innumerable army of residents was shortly added multitudes of wandering birds coming from distant regions. No sooner had the herbage perished, depriving the little victims of cover and food, than the effects of the war became apparent. In autumn the earth so teemed with them that one could scarcely walk anywhere without treading on mice; while out of every hollow weed-stalk lying on the ground dozens could be shaken; but so rapidly had they been devoured by the trained army of persecutors that in spring it was hard to find a survivor, even in the barns and houses.—HUDSON *Naturalist in La Plata*, ch. 3, p. 67. (C. & H., 1895.)

1130. EXCITEMENT AN AID TO FAITH—*Emotional Thrill Gives Sense of Reality—Terror on Precipice's Edge.*—Speaking generally, the more a conceived object excites us, the more reality it has. The same object excites us differently at different times. Moral and religious truths come "home" to us far more on some occasions than on others. As Emerson says, "There is a difference between one and another hour of life in their authority and subsequent effect. Our faith comes in moments, . . . yet there is a depth in those brief moments which constrains us to ascribe more reality to them than to all other experiences." The "depth" is partly, no doubt, the insight into wider systems of unified relation, but far more often than that it is the emotional thrill. Thus, to descend to more trivial examples, a man who has no belief in ghosts by daylight will temporarily believe in them when, alone at midnight, he feels his blood curdle at a mysterious sound or vision, his heart thumping, and his legs impelled to flee. The thought of falling when we walk along a curbstone awakens no emotion of dread; so no sense of reality attaches to it, and we are sure we shall not fall. On a precipice's edge, however, the sickening emotion which the notion of a possible fall engenders makes us believe in the latter's imminent reality, and quite unfits us to proceed.—JAMES *Psychology*, vol. ii, ch. 21, p. 307. (H. H. & Co., 1899.)

1131. EXEMPTION FROM ATTACK INSURES INCREASE—*The Passenger-pigeon —The Fulmar Petrel.*—It is usually the amount of destruction which an animal or plant is exposed to, not its rapid multiplication, that determines its numbers in any country. The passenger-pigeon (*Ectopistes migratorius*) is, or rather was, excessively abundant in a certain area in North America, and its enormous migrating flocks darkening the sky for hours have often been described; yet this bird lays only two eggs. The fulmar petrel exists in myriads at St. Kilda and other haunts of the species, yet it lays only one egg. . . . Some of the grasses and sedges, the wild hyacinth, and many buttercups occur in immense profusion over extensive areas, altho each plant produces comparatively few seeds.—WALLACE *Darwinism*, ch. 2, p. 20. (Hum., 1889.)

1132. EXPANSION EXPLAINED AS VIBRATION—*Planet Viewed through Heated Air.*—But how are we to picture such dilatation [expansion by heat] in accordance with the theory which regards heat as a mode of motion? The comparison of a very great thing with an indefinitely small one will here help us to a clear conception. I once approached Gibraltar on a fine starlight night when the planet Jupiter was sharply defined on a clear sky. On walking, however, past the funnel of the steamer, so as to bring the heated air between me and it, the planet suddenly augmented in apparent size, losing at the same time part of its sharpness of definition. The expansion was evidently due to the heated air, causing the image of the planet to quiver on the retina. This quivering was in all directions, and it was so rapid that the various motions blended upon the retina to a disk of aug-

mented size. If, instead of the planet's light being acted upon by heated air, the planet itself had danced in all directions to and fro, the same apparent augmentation of the disk would have ensued. Jupiter, thus quivering, would virtually fill a greater space than if he were still. The case is similar with our dancing atoms. When, instead of a motionless atom, we have a vibrating one, we must make room not only for the atom itself, but also for the distance over which its motion stretches. The case may be further illustrated by a tuning-fork. Motionless as it is at present, its prongs fit into a certain space; thrown into vibration, the prongs strike against their boundaries, demanding more room.—TYNDALL *Heat a Mode of Motion*, lect. 4, p. 92. (A., 1900.)

1133. EXPANSION OF WATER IN FREEZING—*One Instance under General Law.*—At this temperature [a shade over 39° F.] water attains its maximum density. Seven degrees below this temperature, or at 32° F., the liquid begins to turn into solid crystals of ice, which swims upon water because it is bulkier for a given weight. In fact, this halt of the approaching molecules at the temperature of 39° is but the preparation for the subsequent act of crystallization in which the expansion by cold culminates. Up to the point of solidification the increase of volume is slow and gradual; while in the act of solidification it is sudden and of overwhelming strength. By this force of expansion the Florentine academicians long ago burst a sphere of copper nearly three-quarters of an inch in thickness. . . .

Water is not a solitary exception to an otherwise general law. There are other molecules than those of this liquid which require more room in the solid crystalline condition than in the adjacent molten condition. Iron is a case in point. Solid iron floats upon molten iron exactly as ice floats upon water. Bismuth is a still more impressive case, and we could shiver a bomb as certainly by the solidification of bismuth as by that of water.—TYNDALL *Forms of Water*, pp. 121-124. (A., 1899.)

1134. EXPANSION, UNEQUAL, OF GLASS—*Apparent Strength a Source of Weakness.*—In applying heat to glass vessels, thickness is a source of weakness or liability to fracture, on account of the unequal expansion of the two sides, due to inequality of temperature, which, of course, increases with the thickness of the glass. Besides this, the thickness increases the leverage of the breaking strain.—WILLIAMS *Chemistry of Cookery*, ch. 2, p. 8. (A., 1900.)

1135. EXPECTATION OF SCIENCE VERIFIED—*Meteorites the Dust of Decaying Comets.*—The missing comet [Biela's] was next due at perihelion in the year 1872, and the probability was contemplated by both Weiss and Galle of its being replaced by a copious discharge of falling stars. The precise date of the occurrence was not easily determinable, but Galle thought the chances in favor of November 28. The event anticipated the prediction by twenty-four hours. Scarcely had the sun set in Western Europe on November 27 when it became evident that Biela's comet was shedding over us the pulverized products of its disintegration. The meteors came in volleys from the foot of the Chained Lady, their numbers at times baffling the attempt to keep a reckoning. At Moncalieri, about 8 p. m., they constituted (as Father Denza said) a "real rain of fire." Four observers counted, on an average, four hundred each minute and a half; and not a few fire-balls, equaling the moon in diameter, traversed the sky.—CLERKE *History of Astronomy*, pt. ii, ch. 10, p. 406. (Bl., 1893.)

1136. EXPECTATIONS, EXTRAVAGANT, OF NEW INVENTION—*Proposed Two-mile Telescope.*—The advantages which were at that period [17th century] supposed to be obtainable only by gigantic length led great minds, as is frequently the case, to extravagant expectations. Auzout considered it necessary to refute Hooke, who is said to have proposed the use of telescopes having a length of upward of 10,000 feet (or nearly two miles), in order to see animals in the moon.—HUMBOLDT *Cosmos*, vol. iii, p. 63. (H., 1897.)

1137. EXPECTATIONS OF NATURALISTS DISAPPOINTED—*Ocean Depths Reveal No Wholly New Life.*—It seemed probable, before the despatch of the "Challenger" expedition, that when the dredge and the trawl should be successfully employed in depths of over 2,000 fathoms, a new and remarkable fauna would be brought to light. Some naturalists thought it even possible that, not only would many genera be found alive that are known to us only by their fossilized skeletons in the Secondary and Tertiary rocks, but that there might be many other new creatures whose anatomy would throw much light on the theories of the evolution of the animal series. But none of the great expeditions that have sailed since the year 1874 have yet succeeded in showing that the hopes and wishes of these naturalists were really justified. Altho thousands of species of animals have been described in the volumes that have been devoted to deep-sea work, the number of the sub-kingdoms and classes remains the same, and indeed the number of new families and genera has not been increased in any very unprecedented manner.—HICKSON *Fauna of the Deep Sea*, ch. 5, p. 86. (A., 1894.)

1138. EXPENDITURE, PROFUSE, IN NATURE—*Advantages of Cross-fertilization—Species That Have Perished.*—Profuse expenditure is nothing unusual under Nature, as we see with the pollen of wind-fertilized plants, and in the multitude of seeds and seedlings produced by most plants in com-

parison with the few that reach maturity. In other cases the paucity of the flowers that are impregnated may be due to the proper insects having become rare under the incessant changes to which the world is subject: or to other plants, which are more highly attractive to the proper insects, having increased in number. We know that certain orchids require certain insects for their fertilization. . . . . In those cases in which only a few flowers are impregnated owing to the proper insects visiting only a few, this may be a great injury to the plant; and many hundred species throughout the world have been thus exterminated, those which survive having been favored in some other way. On the other hand, the few seeds which are produced in these cases will be the product of cross-fertilization, and this, as we now positively know, is an immense advantage to most plants.—DARWIN *Fertilization of Orchids*, ch. 9, p. 281. (A., 1898.)

1139. EXPERIENCE, BEES LEARNING BY—*Defense against Death's-head Moth.*—Huber first noticed the remarkable fact that when beehives are attacked by the death's-head moth the bees close the entrance of their hive with wax and propolis to keep out the marauder. The barricade, which is built immediately behind the gateway, completely stops it up—only a small hole being left large enough to admit a bee, and therefore of course too small to admit the moth. Huber specially states that it was not until the beehives had been repeatedly attacked and robbed by the death's-head moth, that the bees closed the entrance of their hive with wax and propolis. Pure instinct would have induced the bees to provide against the first attack. Huber also observed that a wall built in 1804 against the death's-head hawk-moth was destroyed in 1805. In the latter year there were no death's-head moths, nor were any seen during the following. But in the autumn of 1807 a large number again appeared, and the bees at once protected themselves against their enemies.—ROMANES *Animal Intelligence*, ch. 4, p. 184. (A., 1899.)

1140. EXPERIENCE INCLUDES THE LAWS OF MIND—*Instantaneous Perception May Teach Eternal Truth.*—But if "experience" is to be upheld as in any sense the ground and basis of all our knowledge, it must be understood as embracing that most important of all kinds of experience in the study of Nature—the experience we have of the laws of mind. It is one of the most certain of those laws, that in proportion as the powers of the understanding are well developed, and are prepared by previous training for the interpretation of natural facts, there is no relation whatever between the time occupied in the observation of phenomena and the breadth or sweep of the conclusions which may be arrived at from them. A single glance, lasting not above a moment, may awaken the recognition of truths as wide as the universe and as everlasting as time itself.—ARGYLL *Unity of Nature*, ch. 4, p. 86. (Burt.)

1141. EXPERIENCE, LEARNING BY, A PROOF OF MIND—This proof [of the existence of mind] is in all cases and in its last analysis the fact of a living organism showing itself able to learn by its own individual experience. Wherever we find an animal able to do this we have the same right to predicate mind as existing in such an animal that we have to predicate it as existing in any human being other than ourselves.—ROMANES *Animal Intelligence*, int., p. 7. (A., 1899.)

1142. EXPERIENCE THE FOUNDATION OF REMEMBRANCE—Phenomena have absolutely no power to influence our ideas until they have first impressed our senses and our brain. The bare existence of a past fact is no ground for our remembering it. Unless we have seen it, or somehow undergone it, we shall never know of its having been.—JAMES *Psychology*, vol. i, ch. 1, p. 4. (H. H. & Co., 1899.)

1143. EXPERIENCE THE STARTING-POINT OF SCIENCE—We are far distant from the period when it was thought possible to concentrate all sensuous perceptions into the unity of one sole idea of Nature. The true path was indicated upward of a century before Lord Bacon's time, by Leonardo da Vinci, in these few words: "Cominciare dall' esperienza e per mezzo di questa scoprirne la ragione" (commence by experience, and by means of this discover the reason). In many groups of phenomena we must still content ourselves with the recognition of empirical laws; but the highest and more rarely attained aim of all natural inquiry must ever be the discovery of their causal connection. The most satisfactory and distinct evidence will always appear where the laws of phenomena admit of being referred to mathematical principles of explanation.—HUMBOLDT *Cosmos*, vol. iii, p. 10. (H., 1897.)

1144. EXPERIMENT CHANGES PRECONCEIVED THEORY — *Glacier-motion.*—Agassiz appears to have been the first to commence, in 1841, a series of exact measurements to ascertain the laws of glacier-motion, and he soon discovered, contrary to his preconceived notions, that the stream of ice moved more slowly at the sides than at the center, and faster in the middle region of the glacier than at its extremity. Professor James Forbes, who had joined Mr. Agassiz during his earlier investigations in the Alps, undertook himself an independent series of experiments, which he followed up with great perseverance, to determine the laws of glacier-motion. These he found to agree very closely with the laws governing the course of rivers, their progress being greater in the center than at the sides, and more rapid at the surface than at the bot-

tom. This fact was verified by carefully fixing a great number of marks in the ice, arranged in a straight line, which gradually assumed a beautiful curve, the middle part pointing down the glacier, and showing a velocity there double or treble that of the lateral parts. He ascertained that the rate of advance by night was nearly the same as by day, and that even the hourly march of the icy stream could be detected, altho the progress might not amount to more than six or seven inches in twelve hours. By the incessant tho invisible advance of the marks placed on the ice, "time," says Mr. Forbes, "was marked out as by a shadow on a dial, and the unequivocal evidence which I obtained, that even while walking on a glacier we are, day by day, and hour by hour, imperceptibly carried on by the resistless flow of the icy stream, filled me with admiration."—LYELL *Geology*, ch. 15, p. 224. (A., 1854.)

1145. EXPERIMENT CONFIRMS THEORY—*Galileo with Telescope Verifies Reasonings of Copernicus—Jupiter with His Satellites a Little Universe.*—In 1609 Galileo constructed his telescope, and very soon discovered the satellites of Jupiter. This at once confirmed the Copernican theory, by opening before the eyes of men another system, subordinate to the solar, of heavenly bodies revolving about their primaries, thus giving an analogon of the greater. The subsequent discovery by the same instrument of the phases of Venus at once confirmed the new theory of the revolution of the planets about the sun, and answered an objection against it by explaining why Venus did not appear larger when nearer the beholder. Copernicus furnished the suggestion by reflecting on the known fact that the apparent places of objects may be accounted for by the motion of one or both, and that the solution or theory which was the simplest was to be preferred. Galileo, by his telescope, prepared the way for the experiment by enabling observers, in a certain sense, to observe for themselves which moved—the sun or the earth.—PORTER *Human Intellect*, pt. iii, ch. 8, p. 477. (S., 1899.)

1146. ——— ——— *Insectivorous Plants "Fed" and "Starved"—Rapid Growth Due to Animal Food.*—Since the publication of the first edition, several experiments have been made to determine whether insectivorous plants are able to profit by an animal diet.

My experiments were published in *Linnean Society's Journal*, and almost simultaneously the results of Kellermann and Von Raumer were given in the *Botanische Zeitung*. My experiments were begun in June, 1877, when the plants were collected and planted in six ordinary soup-plates. Each plate was divided by a low partition into two sets, and the least flourishing half of each culture was selected to be "fed," while the rest of the plants were destined to be "starved." The plants were prevented from catching insects for themselves by means of a covering of fine gauze, so that the only animal food which they obtained was supplied in very minute pieces of roast meat given to the "fed" plants, but withheld from the "starved" ones. After only ten days the difference between the "fed" and "starved" plants was clearly visible: the fed plants were of brighter green, and the tentacles of a more lively red. At the end of August the plants were compared by number, weight, and measurement, with the following striking results:

	Starved.	Fed.
Weight (without flower-stems)	100	121.5
Number of flower-stems	100	164.9
Weight of stems	100	231.9
Number of capsules	100	194.4
Total calculated weight of seed	100	379.7
Total calculated number of seeds	100	241.5

—DARWIN *Insectivorous Plants* (addition by FRANCIS DARWIN), ch. 1, p. 15. (A., 1900.)

1147. ——— ——— *Scientific Assurance Fulfilled.*—By way of experiment, the sinking of a well was commenced at Paris in 1834, which had reached, in November, 1839, a depth of more than 1,600 English feet, and yet no water ascended to the surface. The government were persuaded by M. Arago to persevere, if necessary, to the depth of more than 2,000 feet; but when they had descended above 1,800 English feet below the surface, the water rose through the tube (which was about ten inches in diameter), so as to discharge half a million of gallons of limpid water every twenty-four hours. The temperature of the water increased at the rate of 1° 8′ F. for every 101 English feet as they went down, the result agreeing very closely with the anticipations of the scientific advisers of this most spirited undertaking.—LYELL *Principles of Geology*, bk. ii, ch. 16, p. 234. (A., 1854.)

1148. EXPERIMENT NECESSARY FOR THE FULL DEVELOPMENT OF A SCIENCE—*What the Ancients Knew of Light.*—But other objects than the motions of the stars attracted the attention of the ancient world. Light was a familiar phenomenon, and from the earliest times we find men's minds busy with the attempt to render some account of it. But without experiment, which belongs to a later stage of scientific development, little progress could be made in this subject. The ancients, accordingly, were far less successful in dealing with light than in dealing with solar and stellar motions. Still they did make some progress. They satisfied themselves that light moved in straight lines; they knew also that light was reflected from polished surfaces, and that the angle of incidence of the rays of light was equal to the angle of reflection. These two results of ancient scientific curiosity constitute the starting-point of [modern scientific knowledge on the subject].—TYNDALL *Lectures on Light*, lect. 1, p. 5. (A., 1898.)

1149. EXPERIMENT REFUTES ANCIENT THEORY—*Scholastic Dictum Shattered at Leaning Tower of Pisa.*—The notion of the attractive force of the earth, unchecked by any right conception of the action of force in producing motion, led the ancients into a very strange error. As the "weight" of a body is the expression of the downward "pull" which the earth exerts upon it, it seemed natural to suppose that the rate of the fall of any heavy body to the ground would increase in proportion to that weight, so that a body weighing ten pounds would fall ten times as fast as a body weighing one pound. And this was formulated as a "law" by Aristotle, and accepted by "educated" mankind as such for nearly two thousand years. . . . Galileo . . . saw that it must be erroneous, as taking no account of the very obvious consideration that while the "pull" of the earth on the weight of ten pounds is ten times as great as it is upon the weight of one pound, it has to give motion to ten times the mass; so that the rates of fall of the two bodies would be the same. His teaching on this subject being opposed by his colleagues, Galileo, in the presence of the whole university, ascended the Leaning Tower, and, dropping from its summit bodies of different weights, he showed that (with an inconsiderable difference, due to the resistance of the air) they reached the bottom in the same times. As the monument of an experiment which gave the death-blow to the unscientific legislation of Aristotle, and prepared the way for the scientific legislation of Newton, the Leaning Tower of Pisa, beautiful in itself as an architectural work, has a far grander interest for all who can appreciate this great step in the emancipation of thought.—CARPENTER *Nature and Man*, p. 371. (A., 1889.)

1150. EXPERIMENT SUPERIOR TO ORDINARY OBSERVATION—*Electricity and Thunder-storm.*—When the scientific investigator is inquiring into the causes of a phenomenon, he does not confine himself to the investigation of things as they are given in ordinary perception. That would never take him to his goal, tho he had at his command the experiences of all time. Thunder-storms have been recorded, indeed carefully described, since the first beginnings of history; but what a storm was could not be explained until the phenomena of electricity had become familiar, until electrical machines had been constructed and experiments made with them. Then the matter was easy. For when once the effects of a storm had been observed and compared with the effect of an electric spark, the inference was plain that the discharge of the machine was simply a storm in miniature. What the observation of a thousand years had left unexplained was understood in the light of a single experiment.—WUNDT *Psychology*, lect. 1, p. 9. (Son. & Co., 1896.)

1151. EXPERIMENT THOUGHT DEGRADING—An aged and learned professor of therapeutics, who occupied himself much with the reorganization of the universities, was urgent with me to divide physiology, in order to restore the good old time; that I myself should lecture on the really intellectual part, and should hand over the lower experimental part to a colleague whom he regarded as good enough for the purpose. He quite gave me up when I said that I myself considered experiments to be the true basis of science.—HELMHOLTZ *Popular Lectures*, lect. 5, p. 219. (L. G. & Co., 1898.)

1152. EXPERIMENTER DIFFERS FROM OBSERVER—I do not question his [Pouchet's] ability as an observer, but the inquiry needed a disciplined experimenter. This latter implies not mere ability to look at things as Nature offers them to our inspection, but to force her to show herself under conditions prescribed by the experimenter himself.—TYNDALL *Floating Matter of the Air*, p. 284. (A., 1895.)

1153. EXPERIMENTS CUMULATIVE—*Demonstrations of Science — Pasteur Traces Fermentation to Living Organisms.*—As in all the conclusions arrived at by Pasteur, so in those relating to fermentation, there were a number of different experiments which were performed by him to elucidate the same point. We will choose one of many in relation to fermentation. If a sugary solution of carbonate of lime is left to itself, after a time it begins to effervesce, carbonic acid is evolved, and lactic acid is formed; and this latter decomposes the carbonate of lime to form lactate of lime. This lactic acid is formed, so to speak, at the expense of the sugar, which little by little disappears. Pasteur demonstrated the cause of this transformation of sugar into lactic acid to be a thin layer of organic matter consisting of extremely small moving organisms. If these be withheld or destroyed in the fermenting fluid, fermentation will cease. If a trace of this gray material be introduced into sterile milk or sterile solution of sugar, the same process is set up, and lactic acid fermentation occurs.—NEWMAN *Bacteria*, ch. 4, p. 112. (G. P. P., 1899.)

1154. EXPERT, INTUITION OF—*Accumulated Associations from Long Experience.*—Saturated with experience of a particular class of materials, an expert intuitively feels whether a newly reported fact is probable or not, whether a proposed hypothesis is worthless or the reverse. He instinctively knows that, in a novel case, this and not that will be the promising course of action. The well-known story of the old judge advising the new one never to give reasons for his decisions—"the decisions will probably be right, the reasons will surely be wrong"—illustrates this. The doctor will

feel that the patient is doomed, the dentist will have a premonition that the tooth will break, tho neither can articulate a reason for his foreboding. The reason lies embedded, but not yet laid bare, in all the countless previous cases dimly suggested by the actual one, all calling up the same conclusion, which the adept thus finds himself swept on to, he knows not how or why.—JAMES *Psychology*, vol. ii, ch. 22, p. 365. (H. H. & Co., 1899.)

1155. EXPLORATION OF ANCIENT GEOLOGIC LANDS AND SEAS—*A Future in the Study of the Past.*—As the ancient geographers were laying the foundation for all our modern knowledge of the present conformation of the globe, so are the geologists of the nineteenth century preparing the ground for future investigators, whose work will be as far in advance of theirs as are the delineations of Carl Ritter, the great master of physical geography in our age, in advance of the map drawn by the old Alexandrian geographer. We shall have our geological explorers and discoverers in the lands and seas of past times, as we have had in those of the present—our Columbuses, our Captain Cooks, our Livingstones in geology, as we have had in geography. There are undiscovered continents and rivers and inland seas in the past world to exercise the ingenuity, courage, and perseverance of men, after they shall have solved all the problems, sounded all the depths, and scaled all the heights of the present surface of the earth.—AGASSIZ *Geological Sketches*, ser. i, ch. 4, p. 97. (H. M. & Co., 1896.)

1156. EXPLORATION OF DEEP SEA—*Required Governmental Aid—Science Demands Concentration of Human Power.*—But the men of science fifty years ago, pushing their inquiries as to the character of the sea-fauna into deeper and deeper water, at length demanded information as to the existence of forms of animal life in the greatest depths. Unable themselves to bear the heavy expenses involved in such an investigation, they sought for and obtained the assistance of the government, in the form of national ships, for the work, and then our knowledge of the depths of the great ocean may be said to have commenced.—HICKSON *Fauna of the Deep Sea*, pref., p. 8. (A., 1894.)

1157. EXPORTATION OF PRODUCTS AND EXHAUSTION OF SOIL—*Home Market Permits Replacement—Poverty of Merely Agricultural Communities.*—The exportation of agricultural products becomes, therefore, a slow but certain method of securing soil exhaustion, and this accounts for the fact that countries, or those portions of countries, which are devoted to almost exclusive agricultural pursuits, thus causing a continuous exportation of agricultural products, become the homes, not of the richest, but of the poorest communities.

It would be useless to deny, in this connection, that our own country, with a soil enriched by centuries of accumulating nitrogen, has grown rich from its agricultural exports. But when the last of our virgin soil shall have been placed under cultivation, a continuous stream of such exports will certainly impoverish the nation, and reduce all who practise such agriculture to the condition which has already been reached by those who have for years grown tobacco, corn, cotton, and wheat on the same soil, and sold the products without paying back to the field the percentage of profits which was its due.

On the other hand, the farmer who is fortunate enough to be permitted to patronize the home market, who sells his maize and takes home a load of manure, adds not only to the plethora of his purse, but also to the fertility of his soil.

Thus in the light of agricultural chemistry we see clearly the deep scientific basis of the teachings of political economy which show the value of the home market. While, therefore, the statement made at the commencement of this address, that the chief factor in the prosperity of a country is its agriculture, remains in every sense true, yet from the data discussed it as readily appears that agricultural prosperity is most intimately connected with the advancement of every other industry. Agricultural chemistry teaches the farmer to welcome the furnace and the mill, for in their proximity he secures a sure return to his fields of the plant-foods removed in his crops.—WILEY *Economical Aspects of Agricultural Chemistry (Proceedings of the Amer. Assoc. for Advancement of Science*, vol. xxxv).

1158. EXTENSION OF INDIVIDUALITY—*Clothing Is Almost Part of Self.*—The body is the innermost part of the material self in each of us; and certain parts of the body seem more intimately ours than the rest. The clothes come next. The old saying that the human person is composed of three parts—soul, body, and clothes—is more than a joke. We so appropriate our clothes and identify ourselves with them that there are few of us who, if asked to choose between having a beautiful body clad in raiment perpetually shabby and unclean, and having an ugly and blemished form always spotlessly attired, would not hesitate a moment before making a decisive reply.—JAMES *Psychology*, vol. i, ch. 10, p. 292. (H. H. & Co., 1899.)

1159. EXTENSION OF KNOWLEDGE THROUGH CONTACT WITH EXTERNAL WORLD—*Promise for Future.*—If art may be said to dwell within the magic circle of the imagination, the extension of knowledge, on the other hand, especially depends on contact with the external world, and this becomes more manifold and close in proportion with the increase of general intercourse. The creation of new organs (in-

struments of observation) increases the intellectual and not unfrequently the physical powers of man. More rapid than light, the closed electric current conveys thought and will to the remotest distance. Forces, whose silent operation in elementary nature, and in the delicate cells of organic tissues, still escape our senses, will, when recognized, employed, and awakened to higher activity, at some future time enter within the sphere of the endless chain of means which enable man to subject to his control separate domains of Nature, and to approximate to a more animated recognition of the universe as a whole.—HUMBOLDT *Cosmos*, vol. ii, pt. ii, p. 355. (H., 1897.)

1160. EXTENSION OF SUGGESTION—*From Waves of Sound to Waves of Light—The Luminiferous Ether—A Priori Judgment of the Creator's Will.*—It was known long ago that sound is conveyed in waves or pulses through the air; and no sooner was this truth well housed in the mind than it was transformed into a theoretic conception. It was supposed that light, like sound, might also be the product of wave-motion. But what, in this case, could be the material forming the waves? For the waves of sound we have the air of our atmosphere; but the stretch of imagination which filled all space with a luminiferous ether trembling with the waves of light was so bold as to shock cautious minds. In one of my latest conversations with Sir David Brewster, he said to me that his chief objection to the undulatory theory of light was that he could not think the Creator guilty of so clumsy a contrivance as the filling of space with ether in order to produce light. This, I may say, is very dangerous ground, and the quarrel of science with Sir David, on this point, as with many estimable persons on other points, is, that they profess to know too much about the mind of the Creator.—TYNDALL *Lectures on Light*, lect. 2, p. 48. (A., 1898.)

1161. EXTENSION OF THE SPECTRUM—*The Invisible Outnumber the Visible Rays.*—A layman would suppose that the endeavors of physicists to lengthen out the visible spectrum would cease with the very considerable additions due to the direct photography of rays ultraviolet and ultrared. But the lay mind knows little of the persistence and address of the accomplished physicist, and can only marvel at the mode in which he summons fresh resources from points of the compass at first seeming the farthest removed from his task. . . . Prof. S. P. Langley, Secretary of the Smithsonian Institution at Washington, has refined the galvanometer into an appliance which he styles the bolometer. Its delicate wire, much thinner than a human hair, through which an electric current constantly passes, and sensitive to much less than the ten-millionth of a degree centigrade, is moved by minute steps through the invisible areas of the solar spectrum; each indication of temperature, automatically photographed, comes out as a line which varies in depth of tone with the intensity of the thermal ray. When the device has finished its journey the larger part of the whole breadth of solar radiation rises to view—in all fifteen times as extensive as the spectrum which Newton saw.—ILES *Flame, Electricity, and the Camera*, ch. 24, p. 346. (D. & McC., 1900.)

1162. EXTERMINATION BY DIVERSION OF SUPPLIES—*Willows on Bank Destroy Watercress in Stream.*—A curious example of the struggle between plants has been communicated to me by Mr. John Ennis, a resident in New Zealand. The English watercress grows so luxuriantly in that country as to completely choke up the rivers, sometimes leading to disastrous floods, and necessitating great outlay to keep the stream open. But a natural remedy has now been found in planting willows on the banks. The roots of these trees penetrate the bed of the stream in every direction, and the watercress, unable to obtain the requisite amount of nourishment, gradually disappears.—WALLACE *Darwinism*, ch. 2, p. 17. (Hum., 1889.)

1163. EXTERMINATION OF GAME BY MODERN WEAPONS—*Survival of Hunting as an Amusement.*—The modern hunter has a vastly increased power of killing game, from the use of firearms instead of the bow and spear which came down from savage times. The effect of bringing in guns is seen among the native American buffalo-hunters. They were always reckless in destruction when they once came within reach of the herds, but now with the help of the white man and the use of his rifles there is such slaughter that travelers have found the ground and air for miles foul with the carcasses of buffaloes, killed merely for the hides and tongues. In the civilized world, what with killing off game, and what with the encroachment of agriculture on the wild lands, both the supply and the need of game for man's subsistence have much lessened. But the hunter's life has been from the earliest times man's school of endurance and courage, where success and even trial gives pleasure in one of its intensest forms. Thus it has come to be kept up artificially where its practical use has fallen away. In civilized countries it is seen at its best where it keeps closest to barbaric fatigue and danger, like grouse-shooting in Scotland, or boar-hunting in Austria; but at its meanest, where it has come down to shooting grain-fed pheasants as tame as barn-door fowls.—TYLOR *Anthropology*, ch. 9, p. 210. (A., 1899.)

1164. EXTERMINATION OF PLANT BY PLANT *(Matt. xiii, 7)*—If turf which has long been mown—and the case would be the same with turf closely browsed by quadrupeds—be let to grow, the more vig-

orous plants gradually kill the less vigorous tho fully grown plants; thus out of twenty species grown on a little plot of mown turf (three feet by four) nine species perished, from the other species being allowed to grow up freely.—DARWIN *Origin of Species*, ch. 1, p. 63. (Burt.)

1165. EXTINCTION OF BISON—*Attempts to Avert.*—The buffalo should be a very interesting animal to all American citizens on account of the great danger which exists of its becoming utterly extinct. Only thirty-one years ago they still numbered several millions, more than five millions at the least, whereas in 1889 there were but some twenty individuals in Texas, a few in Colorado, Wyoming, Montana, and Dakota, and two hundred preserved by the Government in the Yellowstone National Park. We have, however, recently been assured that some private individual citizens in the United States are trying to preserve and propagate the buffalo. Canada, which now exhibits such interesting examples of political and social "survival," has been practically conservative as regards the bison, since it appears that some 500 individuals of a race known as the wood-bison still survive there.—MIVART *Types of Animal Life*, ch. 7, p. 178. (L. B. & Co., 1893.)

1166. EXTINCTION OF OTHER SUNS—*A Like Fate Awaits Our Own.*—In other cases obscure heavenly bodies have discovered themselves by their attraction on adjacent bright stars, and the motions of the latter thereby produced. Thus there are extinct suns. The fact that there are such lends new weight to the reasons which permit us to conclude that our sun also is a body which slowly gives out its store of heat, and thus will some time become extinct.—HELMHOLTZ *Popular Lectures*, lect. 4, p. 190. (L. G. & Co., 1898.)

1167. EXTINCTION OF OUR SUN—*Brevity of Human Existence—Insignificance of Man.*—The term of 17,000,000 years which I have given may perhaps become considerably prolonged by the gradual abatement of radiation, by the new accretion of falling meteors, and by still greater condensation than that which I have assumed in that calculation. But we know of no natural process which could spare our sun the fate which has manifestly fallen upon other suns. This is a thought which we only reluctantly admit; it seems to us an insult to the beneficent Creative Power which we otherwise find at work in organisms and especially in living ones. But we must reconcile ourselves to the thought that, however we may consider ourselves to be the center and final object of creation, we are but as dust on the earth; which again is but a speck of dust in the immensity of space; and the previous duration of our race, even if we follow it far beyond our written history, into the era of the lake-dwellings or of the mammoth, is but an instant compared with the primeval times of our planet when living beings existed upon it whose strange and unearthly remains still gaze at us from their ancient tombs; and far more does the duration of our race sink into insignificance compared with the enormous periods during which worlds have been in process of formation, and will still continue to form when our sun is extinguished, and our earth is either solidified in cold or is united with the ignited central body of our system.—HELMHOLTZ *Popular Lectures*, lect. 4, p. 191. (L. G. & Co., 1898.)

1168. EXTINCTION OF SPECIES—*Fossils Show a Succession of Types.*—First, in regard to the vicissitudes of the living creation, all are agreed that the sedimentary strata found in the earth's crust are divisible into a variety of groups, more or less dissimilar in their organic remains and mineral composition. The conclusion universally drawn from the study and comparison of these fossiliferous groups is this, that at successive periods distinct tribes of animals and plants have inhabited the land and waters, and that the organic types of the newer formations are more analogous to species now existing than those of more ancient rocks. If we then turn to the present state of the animate creation, and inquire whether it has now become fixed and stationary, we discover that, on the contrary, it is in a state of continual flux—that there are many causes in action which tend to the extinction of species, and which are conclusive against the doctrine of their unlimited durability. But natural history has been successfully cultivated for so short a period that a few examples only of local, and perhaps but one or two of absolute, extirpation can as yet be proved, and these only where the interference of man has been conspicuous. It will nevertheless appear evident . . . that man is not the only exterminating agent; and that, independently of his intervention, the annihilation of species is promoted by the multiplication and gradual diffusion of every animal or plant.—LYELL *Principles of Geology*, bk. i, ch. 13, p. 181. (A., 1854.)

1169. EXTRAVAGANCES OF NATURE—*Possibilities of Existence Outrun Imagination.*—"Do not be deterred," said Agassiz, in the course of one of the interviews in which he obligingly indulged the writer of these chapters, who had mentioned to him that one of his opinions, just confirmed by the naturalist, had seemed so extraordinary that he had been almost afraid to communicate it—"do not be deterred, if you have examined minutely, by any dread of being deemed extravagant. The possibilities of existence run so deeply into the extravagant that there is scarcely any conception too extraordinary for Nature to realize."—MILLER *The Old Red Sandstone*, ch. 3, p. 52. (G. & L., 1851.)

1170. EXTREMES MEETING—*Ice Preserved under Molten Rock.*—A thick lava-stream must take an enormous period to cool down—probably many hundreds or even thousands of years. It is possible to walk over lava-streams in which at a few inches below the surface the rock is still red-hot, so that a piece of stick is lighted if thrust into a crack. Lava is a very bad conductor of heat, and loose scoriæ and dust are still worse conductors. During the eruption of Vesuvius in 1872, masses of snow which were covered with a thick layer of scoriæ, and afterwards by a stream of lava, were found three years afterwards consolidated into ice, but not melted. The city of Catania is constantly supplied with ice from masses of snow which have been buried under the ejections of Etna.—JUDD *Volcanoes*, ch. 4, p. 110. (A., 1899.)

1171. EXTREMES OF TEMPERATURE IN AMERICA—*In China*—*"Insular Climates" vs. "Excessive Climates."*—In consequence of the more equal temperature of the waters of the ocean, the climate of islands and of coasts differs essentially from that of the interior of continents, the more maritime climate being characterized by mild winters and more temperate summers; for the sea-breezes moderate the cold of winter as well as the heat of summer. When, therefore, we trace round the globe those belts in which the mean annual temperature is the same, we often find great differences in climate; for there are insular climates in which the seasons are nearly equalized, and excessive climates, as they have been termed, where the temperature of winter and summer is strongly contrasted. The whole of Europe, compared with the eastern parts of America and Asia, has an insular climate. The northern part of China, and the Atlantic region of the United States, exhibit "excessive climates." We find at New York, says Humboldt, the summer of Rome and the winter of Copenhagen; at Quebec, the summer of Paris and the winter of Petersburg. At Peking, in China, where the mean temperature of the year is that of the coasts of Brittany, the scorching heats of summer are greater than at Cairo, and the winters as rigorous as at Upsala.—LYELL *Principles of Geology*, bk. i, ch. 7, p. 94. (A., 1854.)

1172. EXTREMES, OPPOSITE, HAVE SIMILAR EFFECTS—*Drought Produces Torpor Like Cold*—*Crocodile*—*Boa-constrictor.*—Gradually, too, the pools of water, which had been protected from evaporation by the now seared foliage of the fan-palm, disappear. As in the icy North, animals become torpid from cold, so here the crocodile and the boa-constrictor lie wrapped in unbroken sleep, deeply buried in the dried soil. Everywhere the drought announces death, yet everywhere the thirsting wanderer is deluded by the phantom of a moving, undulating, watery surface, created by the deceptive play of the reflected rays of light (the mirage). A narrow stratum separates the ground from the distant palm-trees, which seem to hover aloft, owing to the contact of currents of air having different degrees of heat and therefore of density. Shrouded in dark clouds of dust, and tortured by hunger and burning thirst, oxen and horses scour the plain, the one bellowing dismally, the other with outstretched necks snuffing the wind, in the endeavor to detect, by the moisture in the air, the vicinity of some pool of water not yet wholly evaporated.—HUMBOLDT *Views of Nature*, p. 14. (Bell, 1896.)

1173. ——— ——— *Thirst in Arctic Snow-fields, as in Sahara.*—Their [the Eskimos'] drink consists of blood or water: during the greater part of the year they have considerable difficulty in obtaining sufficient water to satisfy their thirst, and it is much too precious to be used for washing. It may seem surprising that people who are surrounded by snow and ice should suffer from want of water, but the amount of heat required to melt snow is so great that a man without the means of obtaining fire might die of thirst in these arctic regions as easily as in the sandy deserts of Africa. Any direct "resort to snow," says Kane, "for the purpose of allaying thirst, was followed by bloody lips and tongue; it burnt like caustic." When the Eskimos visited Captain Parry, they were always anxious for water, which they drank in such quantities "that it was impossible to furnish them with half as much as they desired."—AVEBURY *Prehistoric Times*, ch. 14, p. 476. (A., 1900.)

1174. EYE, IMPERFECT ACHROMATISM OF—*Eyes Differ in Perception of Color.*—The low dispersive power of water masks, as Helmholtz has remarked, the imperfect achromatism of the eye. With the naked eye I can see a distant blue disk sharply defined, but not a red one. I can also see the lines which mark the upper and lower boundaries of a horizontally refracted spectrum sharp at the blue end, but ill-defined at the red end. Projecting a luminous disk upon a screen, and covering one semicircle of the aperture with a red and the other with a blue or green glass, the difference between the apparent sizes of the two semicircles is in my case, and in numerous other cases, extraordinary. Many persons, however, see the apparent sizes of the two semicircles reversed. If with a spectacle-glass I correct the dispersion of the red light over the retina, then the blue ceases to give a sharply defined image. Thus examined the departure of the eye from achromatism appears very gross indeed.—TYNDALL *Lectures on Light*, lect. 1, p. 30. (A., 1898.)

1175. EYES OF DEEP-SEA ANIMALS—*Can Sunlight Reach Them?*—Within the last few years a few authors have maintained that it is quite possible that a few

rays of sunlight do penetrate even to the greatest depths of the ocean—a view mainly based on the fact that so many deep-sea animals possess extremely perfect and complicated eyes and very brilliant color. . . . There seem to me to be very slight grounds for this view.—HICKSON *Fauna of the Deep Sea*, ch. 2, p. 23. (A., 1894.)

1176. ——— ——— *Difference in Different Zones.*—In the majority of cases [of deep-sea animals] we find that the eyes are either very large or very small. Only in a small minority of cases do we find that the eyes are recorded to be moderate in size. The relation between the large-eyed forms and the small-eyed forms is not the same in all the regions of deep seas. In depths of 300 to 600 fathoms the majority are large-eyed forms. In depths of over 1,000 fathoms, the small-eyed and blind forms are in a majority, altho many large-eyed forms are to be found.—HICKSON *Fauna of the Deep Sea*, ch. 4, p. 68. (A., 1894.)

1177. FABLE FOUNDED ON FACT—*Story of the Avernian Lake—Deadly Exhalations of Volcanoes.*—Many volcanoes, which have sunk into a state of quiescence or extinction like the Solfatara of Naples, exhibit the same tendency to give off great quantities of the powerfully acid gases which act upon the surrounding rocks. . . . At the so-called Grotto del Cane, beside the Lago Agnano, it is the custom to show the presence of this heavy and poisonous gas by thrusting a dog into it, the poor animal being revived before life is quite extinct by pouring cold water over it. At the Büdos Hegy, or "stinking hill," of Transylvania, carbonic acid and sulfureted hydrogen are emitted in considerable quantities, and it is possible to take a bath of the heavy gas, the head being kept carefully above the constant level of the exhalations.

Altho the stories of the ancient Avernian lake, across which no bird could fly without suffocation, and of the Guèvo Upas, or "Poison Valley," of Java, which it has been said no living being can cross, may not improbably be exaggerations of the actual facts, yet there is a basis of truth in them in the existence of old volcanic fissures and craters which evolve the poisonous sulfureted hydrogen and carbonic acid gases.—JUDD *Volcanoes*, ch. 8, p. 214. (A., 1899.)

1178. FABLES ABOUT ORANG—The orang never stands on its hind legs, and all the pictures representing it as so doing are as false as the assertion that it defends itself with sticks and the like.—HUXLEY *Man's Place in Nature*, p. 207. (Hum.)

1179. FACILITY BECOME A SNARE—*Body Holds Perverted Habit—The Motor Memory a Source of Difficulty as well as of Advantage.*—It is by means of the motor memory that we are able to walk, ride, and skate with ease, and if it were not for it we should have the movement cease directly the attention was suspended or temporarily transferred to some other object. Occasionally, the motor memory is found inconvenient, on account of its having become so firmly established in an erroneous direction as to require every effort of the will to overcome it and establish a new action. Every teacher of dancing, riding, or boxing knows how difficult it is to break a pupil of any habit he may have formed. A boxer, for instance, who has for some considerable time raised his right arm every time he strikes with the left, will find the greatest difficulty in striking with the left and keeping the right still. Examples might be given from all classes of coordinated actions, there being often more trouble in unlearning some erroneous movement than would have been required to learn the new one two or three times over.—ELDRIDGE-GREEN *Memory and Its Cultivation*, pt. i, ch. 4, p. 26. (A., 1900.)

1180. FACT NEEDED TO CORRECT THEORY—*Descartes Supposed Transmission of Light Instantaneous—Ingenious Illustration of a Staff.*—Descartes imagined space to be filled with something that transmitted light instantaneously. Firstly, because, in his experience, no measurable interval was known to exist between the appearance of a flash of light, however distant, and its effect upon consciousness; and secondly, because, as far as his experience went, no physical power is conveyed from place to place without a vehicle. But his imagination helped itself farther by illustrations drawn from the world of fact. "When," he says, "one walks in darkness with staff in hand, the moment the distant end of the staff strikes an obstacle the hand feels it. This explains what might otherwise be thought strange, that the light reaches us instantaneously from the sun. I wish thee to believe that light in the bodies that we call luminous is nothing more than a very brisk and violent motion, which, by means of the air and other transparent media, is conveyed to the eye exactly as the shock through the walking-stick reaches the hand of a blind man. This is instantaneous, and would be so even if the intervening distance were greater than that between earth and heaven. It is therefore no more necessary that anything material should reach the eye from the luminous object than that something should be sent from the ground to the hand of the blind man when he is conscious of the shock of his staff." The celebrated Robert Hooke first threw doubt upon this notion of Descartes, but afterwards substantially espoused it. The belief in instantaneous transmission was destroyed by the discovery of Römer [of the measurable velocity of light].—TYNDALL *Lectures on Light*, lect. 2, p. 44. (A., 1898.)

1181. FACT SURPASSES THEORY—*Life in Torrid Heat and Arctic Cold—Life in Other Worlds.*—For instance, if we did

not know that the torrid zone was inhabited, and could not visit that region, but knew nevertheless how tremendous the heat is there, how short the interval from greatest to least heat, and so on, how ready we should be to believe that neither animal nor vegetable life can exist there. And in like manner as to the arctic regions. Supposing we knew only that there are parts of the earth where the sun is sometimes unseen for several successive weeks, and sometimes remains without setting for as long a period, while even in the heart of summer a cold more intense than our bitterest winters prevails, how startling would be the thought (familiar tho it now seems to us) that there are not only living creatures in the arctic regions, but that a race of men exists and thrives there, even preferring their strange abode to the temperate regions which seem to us so much more pleasant! —PROCTOR *Expanse of Heaven*, p. 51. (L. G. & Co., 1897.)

1182. FACTS AND THEORIES OF SCIENCE TO BE DISCRIMINATED—In every physical science we have carefully to distinguish between the facts which form its subject-matter and the theories by which we attempt to explain these facts and group them in our scientific systems. The first alone can be regarded as absolute knowledge, and such knowledge is immutable, except in so far as subsequent observation may correct previous error. The last are, at best, only guesses at truth, and, even in their highest development, are subject to limitations and liable to change.—COOKE *The New Chemistry*, lect. 1, p. 1. (A., 1899.)

1183. FACTS, DEALING WITH, DISPELS ILLUSIONS—*Life Real and Earnest.*—Provided that he remains undisturbed in his study, the purely theoretical inquirer may smile with calm contempt when, for a time, vanity and conceit seek to swell themselves in science and stir up a commotion. Or he may consider ancient prejudices to be interesting and pardonable, as remains of poetic romance or of youthful enthusiasm. To one who has to contend with the hostile forces of fact, indifference and romance disappear; that which he knows and can do is exposed to severe tests; he can only use the hard and clear light of facts, and must give up the notion of lulling himself in agreeable illusions.—HELMHOLTZ *Popular Lectures*, lect. 5, p. 203. (L. G. & Co., 1898.)

1184. FACTS MAY BE TESTED ONE BY ONE—*A Hypothesis Must Stand or Fall as a Whole—Hence Intolerance of Comprehensive Systems.*—One characteristic of the schools which built up their system on such hypotheses, which they assumed as dogmas, is the intolerance of expression which I have already partially mentioned. One who works upon a well-ascertained foundation may readily admit an error; he loses, by so doing, nothing more than that in which he erred. If, however, the starting-point has been placed upon a hypothesis which either appears guaranteed by authority or is only chosen because it agrees with that which it is wished to believe true, any crack may then hopelessly destroy the whole fabric of conviction. The convinced disciples must therefore claim for each individual part of such a fabric the same degree of infallibility; for the anatomy of Hippocrates just as much as for fever crises; every opponent must only appear then as stupid or depraved, and the dispute will thus, according to old precedent, be so much the more passionate and personal, the more uncertain is the basis which is defended. We have frequent opportunities of confirming these general rules in the schools of dogmatic deductive medicine.—HELMHOLTZ *Popular Lectures*, lect. 5, p. 213. (L. G. & Co., 1898.)

1185. FACTS OF EXTERNAL WORLD CORRECTIVE OF ILLUSIONS—*Resolution Can Hold the Mind to Realities.*—However irresistible our sense-illusions may be, so long as we are under the sway of particular impressions or mental images, we can, when resolved to do so, undeceive ourselves by carefully attending to the actual state of things about us. And in many cases, when once the correction is made, the illusion seems an impossibility. By no effort of imagination are we able to throw ourselves back into the illusory mental condition. So long as this power of dispelling the illusion remains with us, we need not be alarmed at the number and variety of the momentary misapprehensions to which we are liable.—SULLY *Illusions*, ch. 6, p. 125. (A., 1897.)

1186. FACTS OF PAST IN FRAME OF PRESENT—*Memory's Unconscious Coloring.*—We tend to project our present modes of experience into the past. We paint our past in the hues of the present. Thus we imagine that things which impressed us in some remote period of life must answer to what is impressive in our present stage of mental development. For example, a person recalls a hill near the home of his childhood, and has the conviction that it was of great height. On revisiting the place he finds that the eminence is quite insignificant. How can we account for this? For one thing, it is to be observed that to his undeveloped childish muscles the climbing to the top meant a considerable expenditure of energy, to be followed by a sense of fatigue. The man remembers these feelings, and "unconsciously reasoning" by present experience, that is to say, by the amount of walking which would now produce this sense of fatigue, imagines that the height was vastly greater than it really was. Another reason is, of course, that a wider knowledge of mountains has resulted in a great alteration of the man's standard of height.—SULLY *Illusions*, ch. 10, p. 268. (A., 1897.)

1187. FACTS OF SCIENCE NOT TO BE FEARED—*All Real Knowledge Increases Reverence—Gives Higher Conceptions of the Creator's Power and Wisdom.*—It is certainly a legitimate exercise of the powers given to man to follow out those paths, whether well marked or as yet little trodden, which seem likely to lead to new knowledge. We need not be troubled by doubts as to the way in which such paths may lead us, so that they really lead to the recognition of facts. We may learn many things inconsistent, perchance, with our present ideas as to the way in which it has pleased the Almighty to provide for his worlds. We may have to abandon some conceptions which had appeared very accordant with the might and wisdom of the Creator. But we may be sure of this, that whatever new ideas we may legitimately be led to will prove not less worthy of him. Increase of knowledge of his universe—whether of its various parts or of the various periods of its history—will enhance our conceptions of his power and wisdom, though still leaving those conceptions infinitely poor and feeble compared with the reality.—PROCTOR *Expanse of Heaven*, p. 174. (L. G. & Co., 1897.)

1188. FACULTIES UNUSED, BUT PERSISTENT—*Opossum on Treeless Plains.*—It is indeed strange to find this animal [the opossum] on the pampas. . . . It shuffles along slowly and awkwardly on the ground, but is a great traveler nevertheless. . . . In every way it is adapted to an arboreal life, yet it is everywhere found on the level country, far removed from the conditions which one would imagine to be necessary to its existence. For how many thousands of years has this marsupial been a dweller on the plain, all its best faculties unexercised, its beautiful grasping hands pressed to the ground, and its prehensile tail dragged like an idle rope behind it! Yet, if one is brought to a tree, it will take to it as readily as a duck to water or an armadillo to earth, climbing up the trunk and about the branches with a monkey-like agility. How reluctant Nature seems in some cases to undo her own work! How long she will allow a specialized organ, with the correlated instinct, to rest without use, yet ready to flash forth on the instant, bright and keen-edged, as in the ancient days of strife, ages past, before peace came to dwell on earth!—HUDSON *Naturalist in La Plata*, ch. 1, p. 18. (C. & H., 1895.)

1189. FAILURE ACCOMPANYING DEVELOPMENT—*Child's "Common Sense" Declining at Maturity.*—It may often be noticed that children display a power of bringing "common sense" to bear upon the ordinary affairs of life, which seems much beyond that of their elders; and yet a very sensible child will often grow into a much less sensible man. Now the reason of this seems to be that the child perceives the application of "self-evident" considerations to the case at issue, without being embarrassed by a number of other considerations (perhaps of a trivial or conventional nature) which distract the attention and unduly influence the judgment of the adult. And the deliverances of a child's "common sense" thus often resemble those of the old "court fools" or "jesters," whose function seems to have been to speak out "home truths" which timid courtiers would not venture to utter. Moreover, as has been well remarked, "it is quite possible for minds of limited power to manage a small range of experience much better than a large, to get confused (as it were) with resources on too great a scale, and therefore to show far more common sense within the comparatively limited field of childish experience than in the greater world of society or public life. This is probably the explanation of a thing often seen—how very sagacious people instinctively shrink from a field which their tact tells them is too large for them to manage, and keep to one where they are really supreme."—CARPENTER *Mental Physiology*, bk. ii, ch. 11, § 383, p. 477. (A., 1900.)

1190. FAILURE OF MEMORY THROUGH INATTENTION—*Common Facts Not Noted by Consciousness—Names Help Recollection.*—I was taking a walk with a relation who was very much interested in botany and anxious to know the names of the different trees and plants. So I went up an avenue (where nearly every second tree was a plane-tree), and pointed out the various trees and shrubs, mentioning their names, but taking no notice of the plane-trees. I then turned into a side avenue of a similar character, and, having reached the center of it, stopped in front of a plane-tree, and asked, "Have you ever seen a similar tree to that before?" and received the answer I expected: "No, I think that must be a very rare tree. I don't remember ever having seen one like it before." We were in sight of two or three dozen at the time, and the great surprise expressed at finding every other tree a plane was amusing.

The reason I chose a plane-tree was that very few people know a plane-tree, and so that great combiner of impressions, a name, was absent.—ELDRIDGE-GREEN *Memory and Its Cultivation*, pt. i, ch. 7, p. 147. (A., 1900.)

1191. FAILURE OF PAST HYPOTHESES—*A Warning for the Present—Molecular Physics—The Atomic Theory.*—In reference to atoms in molecular physics, Sir W. Thomson says, with much weight, that their assumption can explain no property of the body which has not previously been attributed to the atoms. Whilst assenting to this opinion, I would in no way express myself against the existence of atoms, but only against the endeavor to deduce the principles of theoretical physics from purely

hypothetical assumptions as to the atomic structure of bodies. We now know that many of these hypotheses, which found favor in their day, far overshot the mark.—HELMHOLTZ *Popular Lectures*, lect. 1, p. 17. (L. G. & Co., 1898.)

1192. FAILURE THROUGH LACK OF WILL—*Dreamy Irresolution of Coleridge.*—There was probably no man of his time, or perhaps of any time, who surpassed Coleridge in the combination of the reasoning powers of the philosopher with the imagination of the poet and the inspiration of the seer; and there was perhaps not one of the last generation who has left so strong an impress of himself in the subsequent course of thought of reflective minds engaged in the highest subjects of human contemplation. And yet there was probably never a man endowed with such remarkable gifts who accomplished so little that was worthy of them—the great defect of his character being the want of will to turn his gifts to account; so that, with numerous gigantic projects constantly floating in his mind, he never brought himself even seriously to attempt to execute any one of them. It used to be said of him that whenever either natural obligation or voluntary undertaking made it his duty to do anything, the fact seemed a sufficient reason for his not doing it. Thus, at the very outset of his career, when he had found a bookseller (Mr. Cottle) generous enough to promise him thirty guineas for poems which he recited to him, and might have received the whole sum immediately on delivering the manuscript, he went on, week after week, begging and borrowing for his daily needs in the most humiliating manner, until he had drawn from his patron the whole of the promised purchase-money, without supplying him with a line of that poetry which he had only to write down to free himself from obligation. —The habit of recourse to nervine stimulants (alcohol and opium) which he early formed, and from which he never seemed able to free himself, doubtless still further weakened his power of volitional self-control; so that it became necessary for his welfare that he should yield himself to the control of others.—CARPENTER *Mental Physiology*, bk. i, ch. 6, p. 266. (A., 1900.)

1193. FAILURES PAVE THE WAY TO SUCCESS—I mention these failures [of first attempts to gage depth of glaciers] because they give some idea of the discouragements and difficulties which meet the investigator in any new field of research. The student must remember, for his consolation under such disappointments, that his failures are almost as important to the cause of science and to those who follow him in the same road, as his successes. It is much to know what we *cannot* do in any given direction—the first step, indeed, toward the accomplishment of what we *can* do.—AGASSIZ *Geological Sketches*, ser. i, ch. 8, p. 295. (H. M. & Co., 1896.)

1194. FAINTNESS OF IMPRESSION SUGGESTS DISTANCE IN TIME—There is an opposite effect in the case of recent occurrences that, for some reason or another, have left but a faint impression on the memory, tho this fact is not, perhaps, so familiar as the other. I met a friend, we will suppose, a few days since at my club, and we exchanged a few words. My mind was somewhat preoccupied at the time, and the occurrence did not stamp itself on my recollection. To-day I meet him again, and he reminds me of a promise I made him at the time. His reminder suffices to restore a dim image of the incident, but the fact of its dimness leads to the illusion that it really happened much longer ago, and it is only on my friend's strong assurances, and on reasoning from other data that it must have occurred the day he mentions, that I am able to dismiss the illusion.—SULLY *Illusions*, ch. 10, p. 258. (A., 1897.)

1195. FAITH OF SCIENCE—*Assumptions of Psychology.*—Every natural science assumes certain data uncritically, and declines to challenge the elements between which its own "laws" obtain, and from which its own deductions are carried on. Psychology, the science of finite individual minds, assumes as its data (1) thoughts and feelings, and (2) a physical world in time and space with which they coexist and which (3) they know.—JAMES *Psychology*, vol. i, pref., p. 5. (H. H. & Co., 1899.)

1196. FAITH, SCIENCE FOUNDED ON—*The First Law of Motion—Not One Instance of Its Operation Ever Known.*—The law is, that all motion is in itself (that is to say, except as affected by extraneous forces) uniform in velocity and rectilinear in direction. Thus according to this law a body moving, and not subject to any extraneous force, would go on moving forever at the same rate of velocity and in an exactly straight line.

Now, there is no such motion as this existing on the earth or in the heavens. It is an abstract idea of motion which no man has ever, or can ever, see exemplified. Yet a clear apprehension of this abstract idea was necessary to a right understanding and to the true explanation of all the motions which are actually seen. It was long before this idea was arrived at. There was a real difficulty in conceiving it, because not only is there no such motion in Nature, but there is no possibility by artificial means of producing it. It is impossible to release any moving body from the impulses of extraneous force. The first law of motion is therefore a purely abstract idea. It represents a rule which never operates as we conceive it in itself, but is always complicated with other rules which produce a corresponding complication in result. Like many other laws of the same class, it was discovered,

not by looking outward, but by looking inward; not by observing, but by thinking.—ARGYLL *Reign of Law*, ch. 2, p. 65. (Burt.)

1197. FAITH, SCIENCE TEACHES NEED OF—*Our System but a Corner of Space—All History but a Moment of Time.*—How, then, are we to view the startling fact thus brought before us? Must we admit that so much of the Creator's work is vain in truth as in appearance? or, on the other hand, must we reject the evidence of science? As it seems to me, we need do neither one nor the other. We have before us a great mystery; but it is not a new thing to find the ways of God unsearchable by man. Our faith in the wisdom of God need not be shaken unless we assume that our science teaches us the whole of that which is. But inasmuch as science itself has taught us over and over again how little we really know, how little we can know, I think that we may very well believe in this instance that the seeming mystery arises from the imperfectness of our knowledge. If we could see the whole plan of the Creator, instead of the minutest portion; if we could scan the whole of space, instead of the merest corner; if all time were before us, instead of a span—we might pronounce judgment. As it is, what, after all, has science taught us but what we had already learned? "The judgments of God are unsearchable, and his ways past finding out" (Rom. xi. 33; 1 Cor. xiii, 12).—PROCTOR *Our Place among Infinities*, p. 43. (L. G. & Co., 1897.)

1198. FAITHFULNESS THROUGH ALL THINGS—*The Magnetic Needle—Wonderful Power of Magnetism.*—This study of the magnetism of our wandering planet is very interesting, and one which is still very little known. Here is a weak needle, a slip of magnetic iron, which with its restless and agitated finger incessantly seeks a region near the north. Carry this needle in a balloon up to the higher aerial regions, where human life begins to be extinguished; shut it up in a tomb closely separated from the light of day; take it down into the pit of a mine, to more than a thousand yards in depth, and incessantly, day and night, without fatigue and without rest, it watches, trembles, throbs, seeks the point which attracts it across the sky, through the earth, and through the night.—FLAMMARION *Popular Astronomy*, bk. iii, ch. 5, p. 289. (A.)

1199. FAMILY AND HOME PART OF SELF—*The Broadening of Individual Life.*—Our immediate family is a part of ourselves. Our father and mother, our wife and babes, are bone of our bone and flesh of our flesh. When they die, a part of our very selves is gone. If they do anything wrong, it is our shame. If they are insulted, our anger flashes forth as readily as if we stood in their place. Our home comes next. Its scenes are part of our life; its aspects awaken the tenderest feelings of affection; and we do not easily forgive the stranger who, in visiting it, finds fault with its arrangements or treats it with contempt. All these different things are the objects of instinctive preferences coupled with the most important practical interests of life.—JAMES *Psychology*, vol. i, ch. 10, p. 292. (H. H. & Co., 1899.)

1200. FAMILY THE EDUCATOR OF MANKIND—*Love and Righteousness.*—Looking at the mere dynamics of the question, the family contains all the machinery and nearly all the power for the moral education of mankind. Feebly, but adequately, in the early chapters of man's history, it fulfilled its function of nursing love, the mother of all morality; and righteousness, the father of all morality, so preparing a parentage for all the beautiful spiritual children which in later years should spring from them. If life henceforth is to go on at all, it must be a better life, a more loving life, a more abundant life; and this premium upon love means—if it means anything—that evolution is taking henceforth an ethical direction.—DRUMMOND *Ascent of Man*, ch. 9, p. 316. (J. P., 1900.)

1201. FAMILY THE FOUNDATION OF SOCIAL PROGRESS—*The Masterpiece of Evolution.*—If the crowning work of organic evolution is the mammalia, the consummation of the mammalia is the family. Physically, psychically, ethically, the family is the masterpiece of evolution. The creation of evolution, it was destined to become the most active instrument and ally which evolution has ever had. For what is its evolutionary significance? It is the generator and the repository of the forces which alone can carry out the social and moral progress of the world. There they rally when they become enfeebled, there their excesses are counterbalanced, and thence they radiate out, refined and reenforced, to do their holy work.—DRUMMOND *Ascent of Man*, ch. 9, p. 316. (J. P., 1900.)

1202. FAMILY, THE HUMAN, ENDURES THROUGHOUT THE YEAR—*Advance from Conditions of Lower Animals.*—But when man's evolution made a certain progress, and when the mother's care reached mature perfection, it was no longer imperative for children to be born only when the sun was shining and the fruits grew ripe. The parents could now make provision for any weather and for any dearth. They could give their little ones clothes when nights grew cold; they could build barns and granaries against times of famine. In any climate, and at any time, their young were safe; and the old marriage dates, with their subsequent desertions, were struck from the human calendar. So arose, or at least was inaugurated, family life, the first and the last nursery of the higher sympathies, and the home of all that was afterwards holy in the world. One could not

find a simpler instance of the growing sovereignty of mind over the powers of Nature. So remote a cause as the inclination of the earth's axis, and the consequent changes of the seasons, determines the time of marriage for almost the whole animal creation, while man, and a few other forms of life whose environment is exceptional, are able to refuse all such dictations. It was when man's mind became capable of making its own provisions against the weather and the crops that the possibilities of fatherhood, motherhood, and the family were realized.—DRUMMOND *Ascent of Man*, ch. 9, p. 298. (J. P., 1900.)

1203. FAMILY THE UNIT OF SOCIETY—*Lengthened Infancy the Bond of Home Life.*—The primordial unit of human society is the family, and it was by the establishment of definite and permanent family relationships that the step was taken which raised man socially above the level of gregarious apehood. This great point was attained through that lengthening of the period of helpless childhood which accompanied the gradually increasing intelligence of our half-human ancestors. When childhood had come to extend over a period of ten or a dozen years—a period which would be doubled, or more than doubled, where several children were born in succession to the same parents—the relationships between father and mother, brethren and sisters, must have become firmly knit; and thus the family, the unit of human society, gradually came into existence.—FISKE *Destiny of Man*, ch. 9, p. 67. (H. M. & Co., 1900.)

1204. FAMINE, RESOURCE AGAINST—*Aphid-life Concurrent with Ant-life in Winter.*—[Ants] are benumbed in the great cold, but when the season is not too rigorous the depth of their nest places them out of reach of the frost. I have seen them pacing about on the snow and pursuing their habits at this temperature. They would be exposed to the horrors of famine if they did not have resources against such a contingency whenever they are not benumbed, and these resources are no other than the plant-lice, which, by an admirable concurrence of circumstances that we cannot attribute to chance, fall into lethargy at the same degree of cold as the ants and are revived at the same time as they; this the ants always recognize whenever they have need of food.—HUBER *Recherches sur les Mœurs des Fourmis indigènes*, p. 202. (Translated for *Scientific Side-Lights.)*

1205. ——— *Hunting of Aphids When These Are Not Domesticated.*—Those ants that do not know how to collect these useful insects into their own habitations, at least know their retreats, following them to the foot of trees, or upon the roots of shrubs formerly frequented at the first, then darting along the hedges, following the path that will conduct them to their supplies, and carrying back to the republic a little of the honey-colored food, for in winter it requires very little to maintain them.—HUBER *Recherches sur les Mœurs des Fourmis indigènes*, p. 202. (Translated for *Scientific Side-Lights.)*

1206. FARMING OF INSECTS—*The Harvesting-ants—Their Providence and Industry.*—A Texan ant, *Pogonomymex barbatus*, is a harvesting species, storing up especially the grains of *Aristida oligantha*, the so-called "ant-rice," and of a grass, *Buchloe dactyloides*. These ants clear disks, ten or twelve feet in diameter, round the entrance to their nest, a work of no small labor in the rich soil and under the hot sun of Texas. I say "clear disks," but some, tho not all, of these disks are occupied, especially round the edge, by a growth of ant-rice. These ants were first noticed by Mr. Buckley [*Proc. Acad. Nat. Sci.*, Philadelphia, 1860], and their habits were some time afterwards described in more detail by Dr. Lincecum [*Linnean Journal*, 1861, p. 29], who maintained not only that the ground was carefully cleared of all other species of plants, but that this grass was intentionally cultivated by the ants. Mr. McCook ["The Nat. Hist. of the Agricultural Ants of Texas," p. 38], by whom this subject has been recently studied, fully confirms Dr. Lincecum that the disks are kept carefully clean, that the ant-rice alone is permitted to grow on them, and that the produce of this crop is carefully harvested; but he thinks that the ant-rice sows itself, and is not actually cultivated by the ants. I have myself observed in Algeria that certain species of plants are allowed by the ants to grow on their nests.—AVEBURY *Ants, Bees, and Wasps*, ch. 3, p. 61. (A., 1900.)

1207. FASCINATION OF FLAME—*Infant and Insect Alike Attracted—Experience Has Taught Man Caution.*—A brilliant flame is the first object to fix the gaze of the young infant; and in manhood we still continue to feel a strange fascination under the influence of the same phenomenon. Even phosphorescence, unaccompanied as it is by flame, has an irresistible charm for us; while the vivid combustion of inflammable matter embodies a power and impetuosity which rivet the attention of the most stolid observer. We smile at the stupidity of the moth that singes its wings in the candle-flame; but there is within us a similar mysterious impulse that would impel us into the burning mass but for the consciousness of resulting injury, derived solely, as metaphysicians tell us, from knowledge gained by experience.—LOWE *Nature-Studies*, p. 1. (Hum., 1888.)

1208. ——— *Lighthouse a Beacon of Death—Birds of Passage Allured to Destruction.*—The keeper of the lighthouse at Atlantic City describes the migratory birds as following the New Jersey coast all the way up and down in their flights. At

night they fly high, and when they see Absecon Inlet light, which is 167 feet above the ground, they head directly for it. They seem to be attracted in the same way that the moths which flicker around a candle are. If carried along by a heavy wind, they dart against the plate-glass windows surrounding the lens, and drop to the ground dead, bespattering the panes with their blood, to prevent which a wire netting has been constructed on the north and south sides of the lantern. Not long ago a large duck, which was sailing along in a furious storm, was dashed against this netting with such force as to indent it six square inches. When the weather is clear immense numbers of small birds hover about the light after dark, and then, as soon as they have rested on the rail surrounding it, fly off, but soon return again. A large snipe landed so violently against the wirework that he plunged through one of the meshes and stripped himself of all his feathers as far back as the shoulders.—BROWN *Nature-Studies*, p. 13. (Hum., 1888.)

1209. FATALISM, FAILURE OF, INEVITABLE—*Impulse To Take Life Strivingly Is Indestructible.*—Nothing could be more absurd than to hope for the definitive triumph of any philosophy which should refuse to legitimate, and to legitimate in an emphatic manner, the more powerful of our emotional and practical tendencies. Fatalism, whose solving word in all crises of behavior is "All striving is vain," will never reign supreme, for the impulse to take life strivingly is indestructible in the race. Moral creeds which speak to that impulse will be widely successful in spite of inconsistency, vagueness, and shadowy determination of expectancy. Man needs a rule for his will, and will invent one if one be not given him.—JAMES *Psychology*, vol. ii, ch. 21, p. 315. (H. H. & Co., 1899.)

1210. FATHERHOOD ESSENTIAL TO FAMILY LIFE—*The Goal of Evolution.*—Now here is a very pretty problem for evolution. She has at once to make good husbands and good fathers out of lawless savages. Unless this problem is solved the higher progress of the world is at an end. It is the mature opinion of every one who has thought upon the history of the world, that the thing of highest importance for all times and to all nations is family life. When the family was instituted, and not till then, the higher evolution of the world was secured. Hence the exceptional value of the father's development. As the other half of the arch on which the whole higher world is built, his taming, his domestication, his moral discipline, are vital; and in the nature of things this was the next great operation undertaken by evolution.—DRUMMOND *Ascent of Man*, p. 295. (J. P., 1900.)

1211. FATHERHOOD OF GOD—*Primitive Conception of Deity as Recorded in the Vedas—A Descending Evolution Thence.*—One of the most remarkable schools of Christian thought which has arisen in recent times is that which has made the idea of the "Fatherhood of God" the basis of its distinctive teaching. Yet it is nothing but a reversion to the simplest of all ideas, the most rudimentary of all experiences—that which takes the functions and the authority of a father as the most natural image of the invisible and infinite being to whom we owe "life and breath and all things." In the facts of Vedic literature, as now sifted and presented to us by scholars, when we carefully separate these facts from theories about them, there is really no symptom of any time when the idea of some living being in the nature of God had not yet been attained. On the contrary, the earliest indications of this conception are indications of the sublimest character, and the process of evolution seems distinctly to have been a process, not of an ascending, but of a descending order. Thus it appears that the great appellative "Dyaus," which in the earliest Vedic literature is masculine and stood for "the Bright or Shining One," or the Living Being whose dwelling is the light, had in later times become a feminine and stood for nothing but the sky.—ARGYLL *Unity of Nature*, ch. 12, p. 302. (Burt.)

1212. ——— ——— *Sublimity of Early Conceptions—A Personal God Addressed in the Vedas.*—It is quite evident that in the oldest times of the Aryan race, in so far as those times have left us any record, not only had the idea of a personal God been fully conceived, but such a being had been described and addressed in language and under symbols which are comparable with the sublimest imagery in the visions of Patmos. How firmly, too, and how naturally these conceptions of a God were rooted in the analogies of our own human personality is attested by the additional fact that paternity was the earliest Vedic idea of creation, and Dyaus was invoked not only as the heaven-father, but specially as the "Dyaush pitâ ganitâ," which is the Sanskrit equivalent of the Greek Ζεὺς πατὴρ γενετήρ [Zeus, the All-producing Father].—ARGYLL *Unity of Nature*, ch. 12, p. 302. (Burt.)

1213. FAUNA, RANGE OF, DETERMINED BY CLIMATE—*Arctic, Temperate, and Tropical Varieties—Buffalo, Opossum, Raccoon.*—The predominant influence of climate over all the other causes which limit the range of species in the mammalia is perhaps nowhere so conspicuously displayed as in North America. The arctic fauna, so admirably described by Sir John Richardson, has scarcely any species in common with the fauna of the State of New York, which is 600 miles farther south, and comprises about forty distinct mammifers. If again we travel farther south about 600 miles, and enter another zone, running east and west, in South Carolina, Georgia, Alabama, and the contiguous States, we again meet with a

new assemblage of land quadrupeds, and this again differs from the fauna of Texas, where frosts are unknown. It will be observed that on this continent there are no great geographical barriers running east and west, such as high snow-clad mountains, barren deserts, or wide arms of the sea, capable of checking the free migration of species from north to south. But notwithstanding the distinctness of those zones of indigenous mammalia, there are some species, such as the buffalo *(Bison americanus)*, the raccoon *(Procyon lotor)*, and the Virginian opossum *(Didelphys virginiana)*, which have a wider habitation, ranging almost from Canada to the Gulf of Mexico; but they form exceptions to the general rule. The opossum of Texas *(Didelphys carnivora)* is different from that of Virginia, and other species of the same genus inhabit westward of the Rocky Mountains, in California, for example, where almost all the mammalia differ from those of the United States.—LYELL *Principles of Geology*, bk. iii, ch. 37, p. 634. (A., 1854.)

1214. FEAR OF MAN AMONG ANIMALS—*An Acquired Propensity.*—We learn from Mr. Darwin that in the Galapagos archipelago, placed directly under the equator, and nearly 600 miles west of the American continent, all the terrestrial birds, as the finches, doves, hawks, and others, are so tame that they may be killed with a switch. One day, says this author, "a mocking-bird alighted on the edge of a pitcher which I held in my hand, and began quietly to sip the water, and allowed me to lift it with the vessel from the ground." Yet formerly, when the first Europeans landed, and found no inhabitants in these islands, the birds were even tamer than now: already they are beginning to acquire that salutary dread of man which in countries long settled is natural even to young birds which have never received any injury. So in the Falkland Islands, both the birds and foxes are entirely without fear of man; whereas, in the adjoining mainland of South America, many of the same species of birds are extremely wild: for there they have for ages been persecuted by the natives.

Dr. Richardson informs us, in his able history of the habits of the North American animals, that, "in the retired parts of the mountains where the hunters had seldom penetrated, there is no difficulty in approaching the Rocky Mountain sheep, which there exhibit the simplicity of character so remarkable in the domestic species; but where they have been often fired at they are exceedingly wild, alarm their companions on the approach of danger by a hissing noise, and scale the rocks with a speed and agility that baffle pursuit."—LYELL *Principles of Geology*, bk. iii, ch. 35, p. 597. (A., 1854.)

1215. FEAR TAUGHT BY PARENT BIRD—*Young in Shell Know Warning Cry.*—This fear caused by the parent bird's warning note begins to manifest itself even before the young are hatched—and my observations on this point refer to several species in three widely separated orders. When the little prisoner is hammering at its shell, and uttering its feeble peep, as if begging to be let out, if the warning note is uttered, even at a considerable distance, the strokes and complaining instantly cease, and the chick will then remain quiescent in the shell for a long time, or until the parent, by a changed note, conveys to it an intimation that the danger is over.—HUDSON *Naturalist in La Plata*, ch. 5, p. 90. (C. & H., 1895.)

1216. FEAR WITHOUT REASON—*Stage-fright and Shyness.*—Both stage-fright and servile terror may exist with the most indefinite apprehensions of danger, and, in fact, when our reason tells us there is no occasion for alarm. We must, therefore, admit a certain amount of purely instinctive perturbation and constraint, due to the consciousness that we have become objects for other people's eyes. Mr. Darwin goes on to say: "Shyness comes on at a very early age. In one of my own children, two years and three months old, I saw a trace of what certainly appeared to be shyness directed toward myself, after an absence from home of only a week." Every parent has noticed the same sort of thing. Considering the despotic powers of rulers in savage tribes, respect and awe must, from time immemorial, have been emotions excited by certain individuals; and stage-fright, servile terror, and shyness must have had as copious opportunities for exercise as at the present time. Whether these impulses could ever have been useful, and selected for usefulness, is a question which, it would seem, can only be answered in the negative. Apparently they are pure hindrances, like fainting at sight of blood or disease, seasickness, a dizzy head on high places, and certain squeamishnesses of esthetic taste. They are incidental emotions, in spite of which we get along.—JAMES *Psychology*, vol. ii, ch. 24, p. 432. (H. H. & Co., 1899.)

1217. FEELING A SUM OF EXPERIENCES—Experience is remolding us every moment, and our mental reaction on every given thing is really a resultant of our experience of the whole world up to that date.—JAMES *Psychology*, vol. i, ch. 9, p. 234. (H. H. & Co., 1899.)

1218. FEELING, THE DOMINANT—*Molds Images in Dreams.*—The analogy of feeling is a common link between dream-images. Now, if any shade of feeling becomes fixed and dominant in the mind, it will tend to control all the images of the time, allowing certain congruous ones to enter and excluding others. If, for example, a feeling of distress occupies the mind, distressing images will have the advantage in the struggle for existence which

goes on in the world of mind as well as in that of matter. We may say that attention, which is here wholly a passive process, is controlled by the emotion of the time, and bent in the direction of congruent or harmonious images.—SULLY *Illusions*, ch. 7, p. 164. (A., 1897.)

1219. FEELINGS MANIFESTED BY EXPRESSION AND ATTITUDE—*Art Recognizes Bodily Manifestation of Spiritual Attributes.*—The interest of the human presence, in all its various workings, regarded as symptomatic of mental processes, is laid hold of and heightened in the fine art of cultivated nations. To the painter, the sculptor, and the poet, every feeling has its appropriate manifestation. Not merely are the grosser forms of feeling thus linked with material adjuncts; in the artist's view, the loftiest, the noblest, the holiest of the human emotions have their marked and inseparable attitude and deportment. In the artistic conceptions of the Middle Ages, more especially, the most divine attributes of the immaterial soul had their counterpart in the material body: the martyr, the saint, the Blessed Virgin, the Savior himself, manifested their glorious nature by the sympathetic movements of the mortal framework. So far as concerns the entire compass of our feelings or emotions, it is the universal testimony of mankind that these have no independent spiritual subsistence, but are in every case embodied in our fleshly form. This very strong and patent fact has been usually kept out of view in the multifarious discussions respecting the immaterial soul. Apparent as it is to the vulgar, and intently studied as it has been by the sculptor, the painter, and the poet, it has been disregarded both by metaphysicians and by theologians when engaged in settling the boundaries of mind and body.—BAIN *Mind and Body*, ch. 2, p. 3. (Hum., 1880.)

1220. FEINT OF MONKEY—*Pretense of Throwing Things at Enemy.*—When he is angry, and has at hand only those things which he wishes to keep, he makes a great show of throwing them at people, but always retains a hold. Thus if he has had a plaything a long time and is tired of it, he throws it right at a person without the least hesitation; but if he has a new thing which he values, he goes through all the appropriate motions for throwing, but only brings the object down with a noise upon the ground, taking care not to let go his hold.—ROMANES *Animal Intelligence* [extract from diary of author's sister], ch. 17, p. 493. (A., 1899.)

1221. FERMENTATION THE PRODUCT OF LIVING ORGANISMS—*Fermentation Involves a Breaking-down of Complex Bodies.*—We may now return to the work of Pasteur and the question of organized ferments [omitting unorganized ferments like the pepsin of the gastric juice]. Let us preface further remark with an axiom with which Professor Frankland sums up the vitalistic theory of fermentation, which was supported by the researches of Pasteur: "No fermentation without organisms; in every fermentation a particular organism." From these words we gather that there is no one particular organism or vegetable cell to be designated the micro-organism of fermentation, but that there are a number of fermentations each started by some specific form of agent. It is true that the chemical changes induced by organized ferments depend on the life-processes of micro-organisms which feed upon the sugar or other substance in solution, and excrete the product of the fermentation. Fermentation nearly always consists of a process of breaking-down of complex bodies, like sugar, into simpler ones, like alcohol and carbonic acid. —NEWMAN *Bacteria*, ch. 4, p. 115. (G. P. P., 1899.)

1222. FERMENTS IN THE DAIRY—*Inoculation of Cream—Choice Bacilli Preserved and Indefinitely Multiplied—Science Gives New Meaning to the Parable of the Leaven.*—The so-called ripening of cream and of cheese consists solely in the development of active ferments and in the results of the oxidation which they produce. In a successful dairy the ferments which are favorable to the production of the best quality of cream and cheese are alone allowed to act. In a poorly kept dairy every kind of a ferment is allowed to grow at will, and the results of such a slipshod method of control are shown in the bad character of the cheese and the rancid flavor of the butter which are produced. The development of the theory of fermentation, and its application to so many practical purposes, led chemists to investigate the character of the organisms which were found to be active in the dairy. These studies led speedily to the isolation of the ferments of a favorable nature, and to methods of destroying those which produced undesirable products. At the present day we find realized that condition of affairs which I have just alluded to as possible in the future of the fertilization of the soil. A bacillus which is capable of exciting the very best character of fermentation in cream has already been prepared in a pure state and can be delivered to the practical dairymen of the country. This minute and invisible particle of vital matter, when added to sterilized cream, sets up a fermentation which, in its results, produces the most delicious flavor that the best butter can have. A sample of cream thus inoculated is mixed with large quantities of ordinary cream, thus securing the proper fermentation throughout the whole mass. . . . Portions of these inoculated masses may be kept in cold storage. . . . In this manner a minute drop of liquid containing a few of the bacilli in question may serve to impart to thousands of pounds of butter, made during a considerable period

of time, a most delicious and desirable flavor.—WILEY *Relations of Chemistry to Industrial Progress (Address at Purdue University, Lafayette, Ind., 1896*, p. 40).

1223. FERNS, ANCIENT, PRESERVED IN COAL—*Enduring Record of the Evanescent.*—There can be no doubt as to the true nature of the Carboniferous forests; for the structural character of the trees is as strongly marked in their fossil remains as in any living plants of the same character. We distinguish the ferns not only by the peculiar form of their leaves, often perfectly preserved, but also by the fructification on the lower surface of the leaves, and by the distinct marks made on the stem at their point of juncture with it. The leaf of the fern, when falling, leaves a scar on the stem varying in shape and size according to the kind of fern, so that the botanist readily distinguishes any particular species of fern by this means—a birthmark, as it were, by which he detects the parentage of the individual.—AGASSIZ *Geological Sketches*, ser. i, ch. 3, p. 76. (H. M. & Co., 1896.)

1224. FERTILITY DUE TO MICRO-ORGANISMS—*Vitality of the Soil—Plants Die in Sterilized Earth.*—These organisms have been found to exist in innumerable colonies in the soil. The soil is no longer regarded as dead matter, but in the highest degree as a vital organism. The possibility of growing plants has been found to depend directly upon the activity of the micro-organisms of the soil. The progress of chemistry has thus revealed in a new light the relations which it holds to the very base of society. If the activity of the micro-organisms producing oxidations in the soil were destroyed for a single year, nearly the whole of the animal life of the earth would perish of hunger. Already practical results of immense importance have grown out of these achievements of chemical research. They have profoundly impressed the methods of agriculture and systems of fertilization. If pease or beans be planted in a sterilized soil the growth of the plantlet produced will be limited by the nourishment contained in the seed. After a few days of apparently vigorous evolution, during which time the reserve stores of plant-food in the seeds have been consumed, the young plant will wither and die.—WILEY *Relations of Chemistry to Industrial Progress (Address at Purdue University, Lafayette, Ind., 1896*, p. 36).

1225. FERTILITY OF LAND DETERMINED BY MOUNTAINS—*Their Effect on the Rainfall.*—Imagine a southwest wind blowing across the Atlantic towards Ireland. In its passage it charges itself with aqueous vapor. In the south of Ireland it encounters the mountains of Kerry: the highest of these is Magillicuddy's Reeks, near Kil larney. Now the lowest stratum of this Atlantic wind is that which is most fully charged with vapor. When it encounters the base of the Kerry mountains it is tilted up and flows bodily over them. Its load of vapor is therefore carried to a height, it expands on reaching the height, it is chilled in consequence of the expansion, and comes down in copious showers of rain. From this, in fact, arises the luxuriant vegetation of Killarney; to this, indeed, the lakes owe their water-supply. The cold crests of the mountains also aid in the work of condensation.

Note the consequence. There is a town called Cahirciveen to the southwest of Magillicuddy's Reeks, at which observations of the rainfall have been made, and a good distance farther to the northeast, right in the course of the southwest wind, there is another town, called Portarlington, at which observations of rainfall have also been made. But before the wind reaches the latter station it has passed over the mountains of Kerry and left a great portion of its moisture behind it. What is the result? At Cahirciveen, as shown by Dr. Lloyd, the rainfall amounts to 59 inches in a year, while at Portarlington it is only 21 inches.—TYNDALL *Forms of Water*, § 8, par. 81, p. 27. (A., 1899.)

1226. FERTILITY TURNED TO BARRENNESS—*Land Upheaved across Bed of Stream.*—On the mainland near Lima, and on the neighboring island of San Lorenzo, Mr. Darwin found proofs that the ancient bed of the sea had been raised to the height of more than eighty feet above water within the human epoch, strata having been discovered at that altitude containing pieces of cotton thread and plaited rush, together with seaweed and marine shells. The same author learnt from Mr. Gill, a civil engineer, that he discovered in the interior near Lima, between Casma and Huaraz, the dried-up channel of a large river, sometimes worn through solid rock, which, instead of continually ascending towards its source, has, in one place, a steep downward slope in that direction, for a ridge or line of hills has been uplifted directly across the bed of the stream, which is now arched. By these changes the water has been turned into some other course; and a district, once fertile, and still covered with ruins, and bearing the marks of ancient cultivation, has been converted into a desert.—LYELL *Principles of Geology*, bk. ii, ch. 29, p. 502. (A., 1854.)

1227. FETISHISM, ORIGIN OF IDEA AND NAME—*Hasty Generalizations in Study of Religions.*—Professor Max Müller has done memorable service in the analysis and in the exposure which he has given us of the origin and use of the word "fetishism," and of the theory which represents it as a necessary stage in the development of religion. It turns out that the word itself, and the fundamental idea it embodies, is a word and an idea derived from one of those

popular superstitions which are so common in connection with Latin Christianity. The Portuguese sailors who first explored the West Coast of Africa were themselves accustomed to attach superstitious value to beads, or crosses, or images, or charms, and amulets of their own. These were called "feitiços." They saw the negroes attaching some similar value to various objects of a similar kind, and these Portuguese sailors therefore described the negro worship as the worship of "feitiços." President De Brosses, a French philosopher of the Voltairean epoch in literature, then extended the term "fetish" so as to include not only artificial articles, but also such great natural features as trees, mountains, rivers, and animals. In this way he was enabled to classify together, under one indiscriminate appellation, many different kinds of worship and many different stages in the history of religious development or decay. This is an excellent example of the crude theories and false generalizations which have been prevalent on the subject of the origin of religion. First, there is the assumption that whatever is lowest in savagery must have been primeval—an assumption which is in all cases improbable, and in many cases must necessarily be false. Next there is great carelessness in ascertaining what is really true even of existing savages in respect to their religious beliefs. —ARGYLL *Unity of Nature*, ch. 12, p. 284. (Burt.)

1228. FICTIONS OF LAMARCK—*No Known Instance of Acquisition of New Organs.*—I must here interrupt the author's [Lamarck's] argument, by observing that no positive fact is cited to exemplify the substitution of some entirely new sense, faculty, or organ in the room of some other suppressed as useless. All the instances adduced go only to prove that the dimensions and strength of members and the perfection of certain attributes may, in a long succession of generations, be lessened and enfeebled by disuse; or, on the contrary, be matured and augmented by active exertion; just as we know that the power of scent is feeble in the greyhound, while its swiftness of pace and its acuteness of sight are remarkable—that the harrier and staghound, on the contrary, are comparatively slow in their movements, but excel in the sense of smelling.

It was necessary to point out to the reader this important chasm in the chain of evidence, because he might otherwise imagine that I had merely omitted the illustrations for the sake of brevity: but the plain truth is that there were no examples to be found; and when Lamarck talks "of the efforts of internal sentiment," "the influence of subtle fluids," and "acts of organization," as causes whereby animals and plants may acquire new organs, he substitutes names for things; and, with a disregard to the strict rules of induction, resorts to fictions, as ideal as the "plastic virtue," and other phantoms of the geologists of the Middle Ages.—LYELL *Principles of Geology*, bk. iii, ch. 33, p. 571. (A., 1854.)

1229. FIG, DOMESTIC, IN THE UNITED STATES—*Great Fig-tree of Chico, California.*—Fig-culture has never amounted to much as an industry in this country. Fig-trees grow abundantly throughout the South and in California, having been introduced by the early French and Spanish settlers, and there have been more or less frequent importations since. As a domestic fruit, the fig is of considerable importance in all the Gulf and South Atlantic States. It is a common dooryard tree throughout this region. It has been grown with more or less success as far north as the lower Hudson River Valley, and where well cared for during the winter it will bear well for years, even at these northern limits. In the South figs are used almost entirely for household purposes. They are eaten fresh from the tree and are served on the table with sugar and cream. They are also stewed and made into puddings and pies, and are canned and preserved. In this section figs are occasionally, but seldom, dried for household use, as they ripen at the period of summer showers, which makes drying difficult. Much more of an effort to produce a salable dried fig has been made in California than in the South, especially during the last twenty years, and a greater success has been secured, probably on account of the drier climate. Fig-trees were grown in California by the early Spanish padres, probably as early as 1710, and have flourished throughout the southern part of the State, one of the largest and most remarkable trees in America growing as far north as Chico (130 miles north of San Francisco), on the Bidwell place, where it was planted in 1856.

The writer saw this tree in 1898, and it is certainly one of the great horticultural curiosities of the country. It is 11 feet in circumference near the base of the trunk; branches have grown down into the ground and sent up new shoots, and the process has been repeated until a ground space of 150 feet in diameter is covered by this one tree, giving a dense shade over a space big enough to accommodate a large picnic party. —HOWARD *Smyrna Fig Culture in the United States* (*Year-book of the Department of Agriculture, 1900*, p. 79).

1230. FIG, THE SMYRNA, NATURALIZED IN CALIFORNIA—*Failure of Fruit to Mature—Utility of the Wild Variety, or Caprifig, Discovered.*—After the early attempts to dry figs in California had progressed for some years it was gradually realized that with the varieties then growing it was impossible to arrive at a product which should compare in quality or commercial value with the Smyrna fig of com-

merce. As a result, in 1880 and 1882, Mr. Gulian P. Rixford, of the San Francisco *Bulletin*, imported into California, by the aid of E. F. Smithers, United States Consul at Smyrna, and A. Sida, an American merchant in Smyrna, about 14,000 cuttings of the supposedly best varieties of Smyrna fig-trees. These cuttings were widely distributed and were known as the "*Bulletin*" cuttings. This effort received wide newspaper notoriety, and much was expected of it, but when the trees came into bearing it was found that the fruit invariably dropped on or before reaching the size of a marble. . . .

In 1886 Mr. F. Roeding, a banker in San Francisco and proprietor of the Fancher Creek Nurseries of Fresno, having become convinced that California could be made to grow as good a fig as could be grown in Smyrna, sent his foreman, Mr. W. C. West, to Smyrna for the purpose of investigating the fig industry on the spot. Mr. West remained in Smyrna four months and succeeded in securing several thousand Smyrna fig cuttings, as well as cuttings of wild figs and a few of such varieties as are grown for home consumption. He was watched by the people constantly. He was refused the sale of cuttings, and finally succeeded only by buying through a foreign resident, who was not suspected of any intention to export. After a journey of several months the cuttings arrived in Fresno in good condition and were planted in 1888 in the Fancher Creek Nursery, 20 acres being planted that year, 20 more in 1889, and in 1891 an additional 20 acres.

The importation at this time of the wild, or caprifig, cuttings was the most important step which had yet been taken toward the solution of the problem. This importation was due to the tardy recognition of the fact that the Smyrna fig, the standard fig of commerce, owes its peculiar flavor to the number of ripe seeds which it contains, and that these ripe seeds are only to be gained by the fertilization of the flowers of the Smyrna fig with pollen derived from the wild fig, or caprifig. [This, it was discovered, is effected through the interposition of an insect. See INSECTS.] — HOWARD *Smyrna Fig Culture in the United States (Year-book of the Department of Agriculture, 1900*, p. 80).

1231. FIRE AND BROOM AS TOOLS OF WOMAN—*Primitive Cooking Utensils.*—As soon as the tree was felled, or taking advantage of the wind-giant's sport, [women] burned and hacked off a convenient length of the trunk; then, gathering from the forests a supply of fat pine knots, they burned out the cavity of the future boiler. They carefully watched the progress of the fire, and when it threatened to spread laterally they checked its course in that direction by means of strips of green bark or mud or water. As soon as the ashes and charred wood prevented the further action of the fire, this marvelous Gill-at-all-trades re moved the fire and brushed out the débri with an improvised broom of grass. Then by means of a scraper of flint which she ha made, she dug away the charcoal until sh had exposed a clean surface of wood. Th firing and scraping were repeated until th "dugout" assumed the desired form. Th trough completed, it was ready to do th boiling for the family as soon as the mea could be prepared and the stones heate This apprenticeship of fire in wood-workin calls for woman's help in more industrie than one not strictly her own.—MASO *Woman's Share in Primitive Culture,* ch. 2 p. 32. (A., 1894.)

1232. FIRE AND ITS USES—*Fires o Cave-men in the Mammoth Period—Grea Agency Utilized by Man Alone.*—Man under stands fire and deals with it in ways quit beyond the intelligence of the lower animals There is an old story how, in the forests o equatorial Africa, when travelers had gon away in the morning and left their fire burning, the huge manlike apes called pon gos (probably our gorillas) would come an sit round the burning logs till they wen out, not having the sagacity to lay mor wood on. This story is often repeated to contrast human intelligence with the dul ness of even the highest apes. Of cours there had been forest-fires in ages befor man, as when the trees had been set i flames by lightning or by a lava-stream But of all creatures man alone has know how to manage fire, to carry it from plac to place with burning brands, and when it went out to produce it afresh. No savage tribe seems really to have been found so low as to be without fire. In the limestone caverns, among the relics of the mammoth period, morsels of charcoal and burnt bones are found embedded, which show that even in that remote antiquity the rude cave-men made fires to cook their food and warm themselves by.—TYLOR *Anthropology*, ch. 11, p. 260. (A., 1899.)

1233. FIRE A NECESSITY OF CIVILIZATION—*Once Deified—Primitive Fire-worship.*—Remember now that fire is one of the most valuable servants of mankind; that it is the source of all artificial heat and light; that in the steam-engine it is the apparent origin of that power which animates the commerce and the industry of the civilized world; that under its influence iron becomes plastic, and the ores give up their metallic treasures; that it is, in fine, the agent of all the arts—and you cannot wonder that in a ruder age the Romans should have enthroned its presiding deity on Olympus, or the Persians worshiped its supposed essence as divinity itself.—COOKE *Religion and Chemistry*, ch. 3, p. 84. (A., 1897.)

1234. FIRE ENABLES MAN TO SUBDUE THE EARTH—It is scarcely possible to conceive of man without fire. Very early

in history he discovered the Promethean spark, and a train of blessings came with its advent. The light and warmth of the sun were let into his cheerless dwelling. Forests and jungles, with their poisonous malaria, noxious insects, venomous serpents, and ravening beasts were subdued or quickly removed. Life was prolonged by the cooking of food and by the ability to preserve it for future use through drying, smoking, roasting, etc. In the open the hunter sleeps secure from ravenous beasts so long as his fire is burning.

In old archeological sites in Europe, representing the remains of the cave-men of the Mousterian epoch in France and Belgium, are found flints that have been cracked by fire, fragments of charcoal, burnt bones that have been split for the marrow.—MASON *Origins of Invention,* ch. 3, p. 84. (S., 1899.)

1235. FIRE FROM FLINT AND STEEL —*Progress to Friction Matches, Argand Burner, Gas and Electric Lighting.*—One of the most vivid recollections of my childhood is of seeing the cook make tinder in the evening by burning old linen rags, and in the morning, with flint and steel, obtaining the spark which, by careful blowing, spread sufficiently to ignite the thin brimstone match from which a candle was lit and fire secured for the day. The process was, however, sometimes a tedious one, and if the tinder had accidentally got damp, or if the flint were worn out, after repeated failures a light had to be obtained from a neighbor. At that time there were few savages in any part of the world but could obtain fire as easily as the most civilized of mankind. . . . About 1834, phosphorus began to be used with other materials to cause more easy ignition, and by 1840 these matches became so cheap as to come into general use in place of the old flint and steel. . . . Whereas down to the end of the last century our modes of producing and utilizing light were almost exactly the same as had been in use for the preceding two or three thousand years, in the present century we have made no less than three new departures, all of which are far superior to the methods of our forefathers. These are: (1) the improvement in lamps by the use of the principle of the Argand burner and chimney; (2) lighting by coal-gas; and (3) the various modes of electric lighting.—WALLACE *The Wonderful Century,* ch. 4, pp. 26-30. (D. M. & Co., 1899.)

1236. FIRE, ITS SERVICE TO SCIENCE—*Man's Friend and Servant—A Chief Factor of Civilization—Gives Power over Nature.*—Looking back through the long dark vista of human history, the one step in material progress that seems to be really comparable in importance with several of the steps we have just made, was, when fire was first utilized, and became the servant and the friend, instead of being the master and the enemy, of man. From that far distant epoch even down to our day, fire, in various forms and in ever-widening spheres of action, has not only ministered to the necessities and the enjoyments of man, but has been the greatest, the essential factor, in that continuous increase of his power over Nature which has undoubtedly been a chief means of the development of his intellect and a necessary condition of what we term civilization. Without fire there would have been neither a bronze nor an iron age, and without these there could have been no effective tools or weapons, with all the long succession of mechanical discoveries and refinements that depended upon them. Without fire there could be no rudiment even of chemistry, and all that has arisen out of it. Without fire much of the earth's surface would be uninhabitable by man, and much of what is now wholesome food would be useless to him. Without fire he must always have remained ignorant of the larger part of the world of matter and of its mysterious forces. He might have lived in the warmer parts of the earth in a savage or even in a partially civilized condition, but he could never have risen to the full dignity of intellectual man, the interpreter and master of the forces of Nature.—WALLACE *The Wonderful Century,* ch. 1, p. 2. (D. M. & Co., 1899.)

1237. FIRE KINDLED BY PRIMITIVE MAN—*Australian Devices.*—The Australians obtain fire by rubbing together two pieces of wood. The process, however, being one of considerable labor, particularly in damp weather, great care is taken to prevent the fire, when once lighted, from becoming extinguished. For this reason they often carry with them a cone of *Banksia,* which burns slowly.—AVEBURY *Prehistoric Times,* ch. 13, p. 425. (A., 1900.)

1238. ——— ——— *Origin of Flint and Steel—The Fire-drill.*—The fire-drill is a means of converting mechanical force into heat till the burning-point of wood is reached. But all that is really wanted is a glowing hot particle or spark, and this can be far more easily got in other ways. Breaking a nodule of iron pyrites picked up on the seashore, and with a bit of flint striking sparks from it on tinder, is a way of firemaking quite superior to the use of the wooden drill. It was known to some modern savages, even the miserable natives of Terra del Fuego: to the prehistoric men of Europe, as appears from the bits of pyrites found in their caves; and of course to the old civilized world, as witness the Greek name of the mineral, *purites,* or "fiery." Substitute for this a piece of iron, and we have the flint and steel, the ordinary apparatus of nations from their entry into the iron age till modern times. Yet even this has now been so discarded that the old-fashioned kitchen tinder-box with its flint and U-shaped steel, and damper for pre-

paring the tinder from scraps of burnt linen to light the brimstone-match with, has become a curiosity worth securing when found by chance in some farmhouse.—TYLOR *Anthropology*, ch. 11, p. 262. (A., 1899.)

1239. FIRE, KINDLING OF, IN BRAZILIAN FOREST—*Primitive Methods Still in Use—Simple Comfort of Life in Wilderness.*—We landed and prepared for breakfast. It was a pretty spot—a clean, white, sandy beach beneath the shade of wide-spreading trees. Joaquim made a fire. He first scraped fine shavings from the midrib of a bacaba-palm leaf; these he piled into a little heap in a dry place, and then struck a light in his bamboo tinder-box with a piece of an old file and a flint, the tinder being a felt-like, soft substance manufactured by an ant *(Polyrhachis bispinosus)*. By gentle blowing the shavings ignited, dry sticks were piled on them, and a good fire soon resulted. He then singed and prepared the cutia, finishing by running a spit through the body, and fixing one end in the ground in a slanting position over the fire. We had brought with us a bag of farinha and a cup containing a lemon, a dozen or two of fiery red peppers, and a few spoonfuls of salt. We breakfasted heartily when our cutia was roasted, and washed the meal down with a calabash-full of the pure water of the river.—BATES *Naturalist on the River Amazon*, ch. 5, p. 663. (Hum., 1880.)

1240. FIRE LIFTS PALL OF NIGHT—*Makes a Way through Darkness.*—Until the savage could command fire, the clouded evening sky left him as if sightless for toil, for sport, for escape from ravening beasts and sudden tempests. If his feet found a beaten path, it was easy to stray from it in darkness, perchance to pay the penalty with his life. His lowly hearth, heaped with crackling boughs, cheered even more with its light than with its warmth. It drew to its rays the industries of flint and needle: its fitful beam created man's first home.—ILES *Flame, Electricity, and the Camera*, ch. 3, p. 25. (D. & McC., 1900.)

1241. FIRE, RIVERS OF—*Modern Street Quarried through Lava—Man's Inattention to Warnings of Nature.*—Burning torrents have often taken their course through the streets of Torre del Greco, and consumed or enclosed a large portion of the town in solid rock. It seems probable that the destruction of three thousand of its inhabitants in 1631, which some accounts attribute to boiling water, was principally due to one of those alluvial floods which we before mentioned: but, in 1737, the lava itself flowed through the eastern side of the town, and afterwards reached the sea; and, in 1794, another current, rolling over the western side, filled the streets and houses, and killed more than four hundred persons. The main street is now quarried through this lava, which supplied building-stones for new houses erected where others had been annihilated. The church was half buried in a rocky mass, but the upper portion served as the foundation of a new edifice.

The number of the population at present is estimated at fifteen thousand; and a satisfactory answer may readily be returned to those who inquire how the inhabitants can be so "inattentive to the voice of time and the warnings of Nature," as to rebuild their dwellings on a spot so often devastated. No neighboring site unoccupied by a town, or which would not be equally insecure, combines the same advantages of proximity to the capital, to the sea, and to the rich lands on the flanks of Vesuvius. If the present population were exiled, they would immediately be replaced by another, for the same reason that the Maremma of Tuscany and the Campagna di Roma will never be depopulated, altho the malaria fever commits more havoc in a few years than the Vesuvian lavas in as many centuries. The district around Naples supplies one amongst innumerable examples, that those regions where the surface is most frequently renewed, and where the renovation is accompanied, at different intervals of time, by partial destruction of animal and vegetable life, may nevertheless be amongst the most habitable and delightful on our globe.—LYELL *Principles of Geology*, bk. ii, ch. 24, p. 394. (A., 1854.)

1242. FIRE, SACRED, KINDLING OF BY BRAHMANS — *Superstition Consecrates Ancient Usage.*—[In India] tho people have for ages kindled fire for practical use with the flint and steel, yet the Brahmans, to make the sacred fire for the daily sacrifice, still use the barbaric art of violently boring a pointed stick into another piece of wood till a spark comes. Asked why they thus waste their labor when they know better, they answer that they do it to get pure and holy fire. But to us it is plain that they are really keeping up by unchanging custom a remnant of the ruder life once led by their remote ancestors.—TYLOR *Anthropology*, ch. 1, p. 16. (A., 1899.)

1243. FIRE STARTED WITH ICE—*A Paradox of Science.*—And now I will substitute for our glass lens one of a more novel character. In a smooth iron mold a lens of pellucid ice has been formed. Placing it in the position occupied a moment ago by the glass lens, I can see the beam brought to a sharp focus. At the focus I place a bit of black paper, with a little gun-cotton folded up within it. The paper immediately ignites and the cotton explodes. Strange, is it not, that the beam should possess such heating power after having passed through so cold a substance? In his arctic expeditions Dr. Scoresby succeeded in exploding gunpowder by the sun's rays converged by large lenses of ice; here we have succeeded in producing the effect

with a small lens, and with a terrestrial source of heat.—TYNDALL *Lectures on Light*, lect. 5, p. 170. (A., 1898.)

1244. FIRE, THE BEAUTY, MAJESTY, AND UTILITY OF—*A Destroying Power Tamed To Minister to Human Needs.*—Who is not struck with the splendor of a brilliantly lighted hall or theater? Indeed, the beauty and luster imparted to large rooms by judicious lighting have no small share in the production of the vivacity felt by the audience generally. Turning to combustion on a large scale, with flames raging in uncontrollable fury, and material undergoing rapid destruction, there is probably no phenomenon in Nature, except, perhaps, the electric discharge, that impresses us with a stronger feeling of awe. A conflagration, from a bonfire to a building in flames, from a chimney on fire to a blast-furnace belching forth its fiery tongues high into the air, is a fit emblem of ungovernable fury and relentless destruction. But it is more to our present purpose to regard flame as an instrument for good rather than evil. Most of the comforts and luxuries and even necessities of modern civilized life are due directly or indirectly to its agency; indeed, it would be difficult to name an art or manufacture which does not owe to flame its very birth. At home and abroad, in the house, the street, and the mart, we are surrounded by a multitude of substances which have been produced by the application of heat in one form or another.—LOWE *Nature-Studies*, p. 1. (Hum., 1888.)

1245. FIRMNESS OF THE "SOLID EARTH"—*Its Rigidity as Great as that of Steel.*—[Since the attraction of sun and moon acts on land as really as on water, it was suggested in 1868] that this criterion might, by the aid of a prolonged series of exact tidal observations, be practically applied to test the interior condition of our planet. In 1882, accordingly, suitable data extending over thirty-three years having at length become available, Professor G. H. Darwin performed the laborious task of their analysis, with the general result that the "effective rigidity" of the earth's mass must be at least as great as that of steel.—CLERKE *History of Astronomy*, pt. ii, ch. 7, p. 317. (Bl., 1893.)

1246. FISH CANNOT LIVE IN GREAT SALT LAKE—*Lower Organisms Flourish—Aquatic Birds Find Food.*—The brine of the [Great Salt] lake is so concentrated that fish cannot live in it, but it furnishes a congenial home for small crustaceans known as brine shrimps *(Artemia)* and for the larvæ of dipterous insects. These are abundant at certain seasons, but not in such vast numbers as in some of the more alkaline lakes on the west side of the Great Basin. It has been stated that the vast numbers of crustaceans and of larvæ in these waters are due to the fact that there are no fishes or other animals in the lakes that could prey upon them; aquatic birds, however, feed upon them in great numbers, but still they swarm in countless myriads. Their food seems to be minute algæ, of which several species have been described.—RUSSELL *Lakes of North America*, ch. 4, p. 83. (G. & Co., 1895.)

1247. FISH EJECTED FROM VOLCANOES—*Life in Subterranean Lakes—Deluges of Mud in the Andes.*—Deluges are often caused in the Andes by the liquefaction of great masses of snow, and sometimes by the rending open, during earthquakes, of subterranean cavities filled with water. In these inundations fine volcanic sand, loose stones, and other materials which the water meets with in its descent are swept away, and a vast quantity of mud, called "moya," is thus formed and carried down into the lower regions. Mud derived from this source descended, in 1797, from the sides of Tungurahua in Quito, and filled valleys a thousand feet wide to the depth of six hundred feet, damming up rivers and causing lakes. In these currents and lakes of moya, thousands of small fish are sometimes enveloped, which, according to Humboldt, have lived and multiplied in subterranean cavities.—LYELL *Principles of Geology*, bk. ii, ch. 22, p. 348. (A., 1854.)

1248. ——— ——— *Pestilence Resulting from Decay of Volcanic Fishes.*—Subterranean lakes, communicating by various channels with the mountain streams, are frequently formed in deep and vast cavities, either on the declivity or at the base of volcanoes. When the whole mass of the volcano is powerfully shaken by those earthquakes which precede all eruptions of fire in the Andes, the subterranean vaults open and pour forth streams of water, fishes, and tufaceous mud. This singular phenomenon brings to mind the *Pimelodes Cyclopum*, or the Silures of the Cyclops, which the inhabitants of the plateau of Quito call Preñadilla, and of which I gave a circumstantial account soon after my return to Europe. When, on the night between the 19th and 20th of June, 1698, the summit of Mount Carguairazo, situated to the north of Chimborazo, and having an elevation of more than 19,000 feet, fell in, all the country for nearly 32 square miles was covered with mud and fishes. A similar eruption of fish from the volcano of Imbaburu was supposed to have caused the putrid fever which, seven years before this period, raged in the town of Ibarra.—HUMBOLDT *Views of Nature*, p. 367. (Bell, 1896.)

1249. FISH ITS OWN LIGHT-BEARER—In *Opostomias micripnus*, a dark black fish living at a depth of over 2,000 fathoms, there are two rows of ocellar organs running down the sides of the body from the head to the tail. In the living animal they are said

to shine with a reddish luster.—HICKSON *Fauna of the Deep Sea*, ch. 4, p. 78. (A., 1894.)

1250. FISH KILLING HORSES—*The Electric Eel—Electricity in the Waters.*—The crocodile and the jaguar are not, however, the only enemies that threaten the South-American horse; for even among the fishes it has a dangerous foe. The marshy waters of Bera and Rastro are filled with innumerable electric eels, who can at pleasure discharge from every part of their slimy, yellow-speckled bodies a deadening shock. This species of *Gymnotus* is about five or six feet in length. It is powerful enough to kill the largest animals when it discharges its nervous organs at one shock in a favorable direction. It was once found necessary to change the line of road from Uritucu across the steppe, owing to the number of horses which, in fording a certain rivulet, annually fell a sacrifice to these gymnoti, which had accumulated there in great numbers. All other species of fish shun the vicinity of these formidable creatures. Even the angler, when fishing from the high bank, is in dread lest an electric shock should be conveyed to him along the moistened line. Thus, in these regions, the electric fire breaks forth from the lowest depths of the waters.—HUMBOLDT *Views of Nature*, p. 17. (Bell, 1896.)

1251. FISHES ENTICED WITHIN NET—With a humoristic sideglance at human relations, Aelian describes how a delicate Mediterranean fish, called *Scarus*, was caught. A female fish was fastened to a line weighted with lead and then dragged to the spot over which the nets had been spread. Then after the males, in their fatal amorousness, had followed close enough, the fisher would drop his lead into the net, and the female together with the whole of her dazzled following would be dragged within. —HOFFMAN *Das Blei bei den Volkern des Alterthums*. (Translated for *Scientific Side-Lights*.)

1252. FISSURES, VAST AND DEEP, FORMED BY EARTHQUAKES—*Fragility of the "Solid Earth."*—The magnitude of some of the fissures formed during [the Calabrian] earthquake affords startling indications of the tremendous violence of the earth's internal throes. Grimaldi observed in the territory of San Fili a newly formed ravine half a mile long and twenty-five feet deep, and another of similar dimensions in Rosarno. In the district of Plaisano three enormous fissures were formed: one a quarter of a mile long, about thirty feet in width, and 225 feet deep; the second, three-quarters of a mile long, 150 feet broad, and 100 feet deep; and the third, nearly a mile long, 105 feet broad, and thirty feet deep. If any evidence were required as to the true nature of the disturbance, it would be found in the remarkable motions of masses slightly attached to the surface soil. Paving-stones were flung into the air, masses of loose soil flung in showers over the surrounding objects.—PROCTOR *Notes on Earthquakes*, p. 4. (Hum., 1887.)

1253. FIXITY IN CHANGE—*The Cloud about a Mountain-top.*—Mr. Daniell has observed, in his meteorological essays, that a cloud sometimes appears fixed on a mountain summit, while the wind continues to blow over it. The same phenomenon here presented a slightly different appearance. In this case the cloud was clearly seen to curl over, and rapidly pass by the summit, and yet was neither diminished nor increased in size. The sun was setting, and a gentle southerly breeze, striking against the southern side of the rock, mingled its current with the colder air above; and the vapor was thus condensed: but as the light wreaths of cloud passed over the ridge, and came within the influence of the warmer atmosphere of the northern sloping bank, they were immediately redissolved. — DARWIN *Naturalist's Voyage around the World*, ch. 2, p. 28. (A., 1898.)

1254. FIXITY OF SOLIDS DELUSIVE—*The Flowing of Metals—Lead and Gold Interpenetrate Each Other.*—One of the most characteristic properties of gases and liquids is that of readily mixing together when placed in contact. But it has recently been shown that solids also mix, tho very much more slowly. If a cube of lead is placed upon one of gold, the surfaces of contact being very smooth and true, and be left without any pressure but their own weight, and at ordinary temperatures, for about a month, a minute quantity of gold will be found to have permeated through the lead, and can be detected in any part of it. Metals may thus be said to flow into each other.—WALLACE *The Wonderful Century*, ch. 7, p. 56. (D. M. & Co., 1899.)

1255. FIXITY OF THE EARTH ONCE ASSUMED—*Cosmogony of Homer—Thought of the Earth as Detached a Surprise—All Subterfuges of Support Fail—"He Stretcheth Out the North over the Empty Place, and Hangeth the Earth upon Nothing" (Job xxvi, 7).*—At the epoch of Homer (about 900 years before our era) it was believed that the earth, surrounded by the river Okeanos, filled the lower half of the celestial sphere, while the upper half extended above, and that Helios (the sun) extinguished his fires each evening and relit them in the morning after bathing in the deep waters of the ocean. . . . Many Greek astronomers still believed, 2,000 years ago, that the stars were fires fed by exhalations from the earth. They were soon forced to remark that the sun, the moon, the planets, and the stars rise and set, and that during the hours which elapse between their setting and their rising it was absolutely necessary that the stars should pass under the earth. Under the earth! What a revolution is in these three words! Up to that time they

had supposed that the world extended to infinity below our feet, solidly founded forever, and, without comprehending this infinite extension of matter, they remained in ignorance and believed in the firm solidity of the earth. But when the curves described by the stars above our heads were continued, after they set below the horizon, to start again when they rose, it was necessary to imagine the earth pierced right through with tunnels large enough to permit the passage of the celestial torches. . . . But the idea of supporting the earth on mountains or otherwise only evades the difficulty, for these mountains, elephants, or columns would, of course, require to rest on some lower foundation. As, moreover, the sky seems to turn round in one piece, the subterfuges invented in order to preserve for the earth something of its [supposed] original stability at last disappeared by the force of circumstances, and they were obliged to admit that *the earth is isolated in all its parts*.—FLAMMARION *Popular Astronomy*, ch. 1, p. 5. (A.)

1256. FLAME THE FRANKENSTEIN OF ALCHEMISTS—*The Real Wonder-worker—Man Must Work with Nature's Laws.*—Flame was the mighty Frankenstein to whom the old alchemists looked for aid in their visionary schemes of transmutation: but since the time of those assiduous but misguided philosophers, flame has worked greater wonders than ever entered into their wildest fancies. The diligent experimenter may be assured that much still remains undisclosed, and that by means of the Bunsen burner, blowpipe, and blast-gas furnace, discoveries have yet to be made which will, at the same time, startle and benefit the world. Our experiments, however, must not be simply tentative; they must be begun, continued, and ended in accordance with physical laws, which will never change, whatever may be the ultimate revolution in scientific theories. By heat the elements can be separated, and by the same agency they can be combined; the more perfect, therefore, our knowledge of chemical action and reaction, the more likely are our researches to terminate in satisfactory results.—LOWE *Nature-Studies*, p. 10 (Hum., 1888.)

1257. FLAVORS AND ODORS CHEMICALLY PRODUCED — *Fruit-sirups — Old Wines and Whiskies Successfully Imitated.*—The delicious fruit-sirups expressly prepared from the fruits themselves, which we find advertised at the alleged soda-fountains, are, in most cases, the products of the chemical laboratory. The achievements of synthetic conquest have been pushed even to a greater extent, and we find it possible to produce mixtures of ethers and essential oils, the pure fabrications of the chemist, which resemble in every respect the natural products arising from the aging of whisky and wine. With a half-dozen bottles of essences which you may purchase in Cincinnati, a barrel of alcohol which you can get from one of Uncle Sam's bonded warehouses, and a pound of burnt sugar which you can make yourself, you can in a few hours make two barrels and a half of ten-year-old Bourbon. In this day, when great universities spring up in a night, with all the facilities and appointments which centuries were supposed to produce, it is not so strange to find the chemist also annihilating time and obliterating space.—WILEY *Relations of Chemistry to Industrial Progress (Address at Purdue University, Lafayette, Ind., 1896*, p. 30).

1258. FLIGHT OF BIRDS A NATURAL GIFT—*Young Swallows Fly Perfectly with No Instruction.*—Mr. Spalding's observations on this point are conclusive as to birds (*Nature*, xii, 507):

"Birds," he says, "do not learn to fly. Two years ago I shut up five unfledged swallows in a small box, not much larger than the nest from which they were taken. The little box, which had a wire front, was hung on the wall near the nest, and the young swallows were fed by their parents through the wires. In this confinement, where they could not even extend their wings, they were kept until after they were fully fledged. . . . On going to set the prisoners free, one was found dead. . . . The remaining four were allowed to escape one at a time. Two of these were perceptibly wavering and unsteady in their flight. One of them, after a flight of some ninety yards, disappeared among some trees." No. 3 and No. 4 "never flew against anything, nor was there, in their avoiding objects, any appreciable difference between them and the old birds. No. 3 swept round the Wellingtonia, and No. 4 rose over the hedge, just as we see the old swallows doing every hour of the day. I have this summer verified these observations. Of two swallows I had similarly confined, one, on being set free, flew a yard or two close to the ground, rose in the direction of a beech-tree, which it gracefully avoided; it was seen for a considerable time sweeping round the beeches and performing magnificent evolutions in the air high above them. The other, which was observed to beat the air with its wings more than usual, was soon lost to sight behind some trees. Titmice, tomtits, and wrens I have made the subjects of similar observations, and with similar results."—JAMES *Psychology*, vol. ii, ch. 24, p. 406. (H. H. & Co., 1899.)

1259. FLOOD AT TIVOLI—*Church and Dwellings Destroyed—Ancient Pagan Temple Spared.*—The younger Pliny, it will be remembered, describes a flood on the Anio, which destroyed woods, rocks, and houses, with the most sumptuous villas and works of art. For four of five centuries consecutively, this "headlong stream," as Horace truly called it, has often remained within

its bounds, and then, after so long an interval of rest, has at different periods inundated its banks again, and widened its channel. The last of these catastrophes happened 15th Nov., 1826, after [continuous] heavy rains. . . . The waters appear also to have been impeded by an artificial dike, by which they were separated into two parts, a short distance above Tivoli. They broke through this dike, and leaving the left trench dry, precipitated themselves, with their whole weight, on the right side. Here they undermined, in the course of a few hours, a high cliff, and widened the river's channel about fifteen paces. On this height stood the church of St. Lucia, and about thirty-six houses of the town of Tivoli, which were all carried away, presenting, as they sank into the roaring flood, a terrific scene of destruction to the spectators on the opposite bank. As the foundations were gradually removed, each building, some of them edifices of considerable height, was first traversed with numerous rents, which soon widened into large fissures, until at length the roofs fell in with a crash, and then the walls sunk into the river, and were hurled down the cataract below.

The destroying agency of the flood came within two hundred yards of the precipice on which the beautiful temple of Vesta stands; but fortunately this precious relic of antiquity was spared, while the wreck of modern structures was hurled down the abyss.—LYELL *Principles of Geology*, bk. ii, ch. 14, p. 212. (A., 1854.)

1260. FLOOD IN THE WHITE MOUNTAINS—*Mountain Stream Becomes a Torrent—Death Found in Seeking Refuge.*—Two dry seasons in the White Mountains, in New Hampshire (United States), were followed by heavy rains on the 28th of August, 1826, when from the steep and lofty declivities which rise abruptly on both sides of the River Saco innumerable rocks and stones, many of sufficient size to fill a common apartment, were detached, and in their descent swept down before them, in one promiscuous and frightful ruin, forests, shrubs, and the earth which sustained them. Altho there are numerous indications on the steep sides of these hills of former slides of the same kind, yet no tradition had been handed down of any similar catastrophe within the memory of man, and the growth of the forest on the very spots now devastated clearly showed that for a long interval nothing similar had occurred. One of these moving masses was afterwards found to have slid three miles, with an average breadth of a quarter of a mile. The natural excavations commenced generally in a trench a few yards in depth and a few rods in width, and descended the mountains, widening and deepening till they became vast chasms. At the base of these hollow ravines was seen a confused mass of ruins, consisting of transported earth, gravel, rocks, and trees. Forests of spruce-fir and hemlock, a kind of fir somewhat resembling our yew in foliage, were prostrated with as much ease as if they had been fields of grain; for, where they disputed the ground, the torrent of mud and rock accumulated behind till it gathered sufficient force to burst the temporary barrier.

The valleys of the Ammonoosuc and Saco presented, for many miles, an uninterrupted scene of desolation, all the bridges being carried away, as well as those over their tributary streams. In some places the road was excavated to the depth of from fifteen to twenty feet; in others it was covered with earth, rocks, and trees to as great a height. The water flowed for many weeks after the flood, as densely charged with earth as it could be without being changed into mud, and marks were seen in various localities of its having risen on either side of the valley to more than twenty-five feet above its ordinary level. Many sheep and cattle were swept away, and the Willey family, nine in number, who in alarm had deserted their house, were destroyed on the banks of the Saco; seven of their mangled bodies were afterwards found near the river, buried beneath driftwood and mountain ruins.—LYELL *Principles of Geology*, bk. ii, ch. 14, p. 209. (A., 1854.)

1261. FOOD DEEPLY AFFECTS ORGANISM—*Diet Changes Color of Birds.*—In some instances it is known that a bird's color is affected by the nature of its food. It is a common practise among bird fanciers to alter the color of canaries from yellow to orange-red by feeding them on red pepper. This food, however, is said to have no effect upon adult birds, but must be fed to nestlings. Sauermann's experiments, as quoted by Beddard, show that the red color is not caused by the capsicin or red pigment in the pepper, but by a fatty substance termed triolein. Fed to white fowls, their breasts became red, while the rest of the plumage remained unchanged. It is also stated that dealers alter the color of green parrots to yellow by feeding them on the fat of certain fishes.—CHAPMAN *Bird-Life*, ch. 3, p. 39. (A., 1900.)

1262. FOOD, DEFINITION AND PURPOSE OF—*Heat and Energy Partial Results—The Building-up of the Body—Construction of Protoplasm the Great Requisite.*—We must decide what we mean by a food, and upon what depend its nourishing qualities. The answer of the current doctrines is that the purpose of a food is to supply, by its oxidation, energy to the organism for its activity and heat. This definition is, to say the least, one-sided, because it completely ignores another very important function of food; namely, its purpose of serving for the construction of the organism. We know that the growing organism can grow only by means of the substances furnished by food: accordingly, that every organism, including the full-grown, can replace what is lost

through physiological functions or disease only by food. For this function of food, which, unfortunately, is often neglected in the theoretical discussions, it is not the caloric value, the latent energy, contained in a substance, but its constructive value, *i. e.*, its power to take part in the building-up of the body, that is of importance. The same holds good for all the substances serving as food for green plants, which consist of completely oxidized compounds, and which hence possess no fuel-value. Yet plants live and breathe as well as animals; their protoplasm shows irritability as well as that of animals, and also develops heat and other vital energies by its activity. In this case we see the customary theory, that food is the bearer of energy, does not hold good, because here the nourishment does not contain energy and can only serve to build up the vegetable organism.

Moreover, certain inorganic substances are indispensable for the animal organism, the growing as well as the full-grown one, and these are in part the same, potassium, calcium, magnesium, and iron compounds, which the plants require for their growth. These facts are inexplicable on the basis of the theory that the purpose of food is to furnish the body with energy, but they are at once clear when we assume that these combinations are used by the animal as well as the vegetable organism for the formation and replacing of protoplasm.

The same is true with regard to the organic elements of animal food. As long as we think they are simply consumed in the fluids of the body for the purpose, as we have heard, of furnishing material for heat and energy, the doctrine of nutrition will labor with a list of enigmas and contradictions which submit to solution in the simplest way as soon as we recognize the other possibility that they are also employed for the construction and reconstruction of the living and working protoplasm. —KASSOWITZ *Is Alcohol a Food or a Poison?* A paper, p. 9. (Translation by Mrs. J. H. W. STUCKENBERG.)

1263. FOOD, FALLACIES REGARDING —*Analysis of Substances in Raw State—Cookery Ignored—Assimilation Unheeded.*—A great many fallacies are continually perpetrated not only by ignorant people, but even by eminent chemists and physiologists. In many chemical and physiological works may be found elaborately minute tables of the chemical composition of certain articles of food, and with these the assumption (either directly stated or implied as a matter of course) that such tables represent the practical nutritive value of the food. The illusory character of such assumption is easily understood. In the first place the analysis is usually that of the article of food in its raw state, and thus all the chemical changes involved in the process of cookery are ignored.

Secondly, the difficulty or facility of assimilation is too often unheeded. This depends both upon the original condition of the food and the changes which the cookery has produced—changes which may double its nutritive value without effecting more than a small percentage of alteration in its chemical composition as revealed by laboratory analysis.—WILLIAMS *Chemistry of Cookery*, ch. 1, p. 5. (A., 1900.)

1264. FOOD, NATURAL CONSTITUENTS NEEDED IN—*Gelatin Will Not Support Life—The "Bone-soup" Experiments of the French Academy.*—About fifty or sixty years ago the French Academy of Sciences appointed a bone-soup commission, consisting of some of the most eminent savants of the period. They worked for above ten years upon the problem submitted to them, that of determining whether or not the soup made by boiling bones until only their mineral matter remained solid, is, or is not, a nutritious food for the inmates of hospitals, etc. In the voluminous report which they ultimately submitted to the Academy they decided in the negative. Baron Liebig became the popular exponent of their conclusions, and vigorously denounced gelatin as not merely a worthless article of food, but as loading the system with material that demands wasteful effort for its removal. The academicians fed dogs on gelatin alone [and] found that they speedily lost flesh, and ultimately died of starvation. A multitude of similar experiments showed that gelatin alone will not support animal life, and hence the conclusion that pure gelatin is worthless as an article of food, and that ordinary soups containing gelatin owed their nutritive value to their other constituents.—WILLIAMS *Chemistry of Cookery*, ch. 4, p. 36. (A., 1900.)

1265. FOOD, NECESSITY OF, A CAUSE OF MIGRATION—*Prevision of Unknown Peril.*—Food, and the necessity for obtaining it, have been adduced as the principal causes of migration from north to south or from east to west, and to a certain extent this is true. The birds which breed in the arctic regions, and along the shores of Russia, Siberia, and the "barren lands" of North America, the snow buntings, the geese, the ducks, the turnstones, and a host of others, must necessarily seek milder latitudes if they are to live when the snow covers their feeding-grounds, while it is equally evident that insect-eating birds, like the swallow, cannot remain long in regions from which insect life disappears for several months in the year.—BROWN *Nature-Studies*, p. 16. (Hum., 1888.)

1266. FOOD OF DEEP-SEA ANIMALS —*Must Descend from Surface.*—The absence of vegetable life is an important point in the consideration of the abysmal fauna, for it is in consequence necessary to bear in mind that the food of deep-sea animals must be derived from the surface. It is possible that deep-sea fish, in some cases, feed upon

one another and upon deep-sea crustacea, that deep-sea crustacea feed upon deep-sea worms, that deep-sea echinoderms feed upon deep-sea foraminifera, and so on through all the different combinations; but the fauna would soon become exhausted if it had no other source of food-supply. This other source of food-supply is derived from the bodies of pelagic organisms that fall from the upper waters of the ocean, and is composed of protozoa, floating tunicates, crustacea, fish, and other animals, together with diatoms and fragments of seaweed.—HICKSON *Fauna of the Deep Sea*, ch. 2, p. 43. (A., 1894.)

1267. FOOD OF ENTOMBED RHINOCEROS—*Science Brings Past to Present.*—In 1772, Pallas obtained from Wiljuiskoi, in lat. 64°, from the banks of the Wiljui, a tributary of the Lena, the carcass of a rhinoceros *(R. tichorhinus)*, taken from the sand in which it must have remained congealed for ages, the soil of that region being always frozen to within a slight depth of the surface. This carcass was compared to a natural mummy, and emitted an odor like putrid flesh, part of the skin being still covered with black and gray hairs. So great, indeed, was the quantity of hair on the foot and head conveyed to St. Petersburg, that Pallas asked whether the rhinoceros of the Lena might not have been an inhabitant of the temperate regions of middle Asia, its clothing being so much warmer than that of the African rhinoceros.

Professor Brandt, of St. Petersburg, in a letter to Baron Alexander von Humboldt, dated 1846, adds the following particulars respecting this wonderful fossil relic: "I have been so fortunate as to extract from cavities in the molar teeth of the Wiljui rhinoceros a small quantity of its half-chewed food, among which fragments of pine-leaves, one-half of the seed of a polygonaceous plant, and very minute portions of wood with porous cells (or small fragments of coniferous wood), were still recognizable.—LYELL *Principles of Geology*, bk. i, ch. 6, p. 80. (A., 1854.)

1268. FOOD OF PLANT PRESERVED TILL CONSUMED—*Antiseptic Power of Secretion of Sundew.*—The secretion seems to possess, like the gastric juice of the higher animals, some antiseptic power. During very warm weather I placed close together two equal-sized bits of raw meat, one on a leaf of the *Drosera* [sundew], and the other surrounded by wet moss. They were thus left for 48 hours, and then examined. The bit on the moss swarmed with infusoria, and was so much decayed that the transverse *striæ* on the muscular fibers could no longer be clearly distinguished; whilst the bit on the leaf, which was bathed by the secretion, was free from infusoria, and its *striæ* were perfectly distinct in the central and undissolved portion. In like manner small cubes of albumin and cheese placed on wet moss became threaded with filaments of mold, and had their surfaces slightly discolored and disintegrated; whilst those on the leaves of *Drosera* remained clean, the albumin being changed into transparent fluid.—DARWIN *Insectivorous Plants*, ch. 1, p. 12. (A., 1898.)

1269. FOOD OF SAVAGES—*Snakes, Lizards, Grubs, and Ants Eaten by Rude Tribes—Dearth in Lack of Agriculture.*—His [man's] first need is to get his daily food. In tropical forests, savages may easily live on what Nature provides, like the Andaman Islanders, who gather fruits and honey, hunt wild pigs in the jungle, and take turtle and fish on the coast. Many forest tribes of Brazil, tho they cultivate a little, depend mostly on wild food. Of such the rude man has no lack, for there is game in plenty and the rivers swarm with fish, while the woods yield him a supply of roots and bulbs, calabashes, palm-nuts, beans, and many other fruits; he collects wild honey, birds' eggs, grubs out of rotten wood, nor does he despise insects, even ants. In less fertile lands savage life goes on well while game and fish abound, but when these fail it becomes an unceasing quest for food, as where the Australians roam over their deserts on the lookout for every eatable root or insect, or the low Rocky Mountain tribes gather pine-nuts and berries, catch snakes, and drag lizards out of their holes with a hooked stick.—TYLOR *Anthropology*, ch. 9, p. 206. (A., 1899.)

1270. FOOD OF THE WORLD FOUND IN FRUITS AND SEEDS—*Vegetable Altruism—The Plant Lives for Others.*—All animals, in the long run, depend for food upon fruits and seeds, or upon lesser creatures which have utilized fruits and seeds. Three-fourths of the population of the world at the present moment subsist upon rice. What is rice? It is a seed; a product of reproduction. Of the other fourth, three-fourths live upon grains—barley, wheat, oats, millet. What are these grains? Seeds—stores of starch or albumin which, in the perfect forethought of reproduction, plants bequeath to their offspring. The foods of the world, especially the children's foods, are the foods of the children of plants, the foods which unselfish activities store round the cradles of the helpless, so that when the sun wakens them to their new world they may not want. Every plant in the world lives for others. It sets aside something, something costly, cared for, the highest expression of its nature.—DRUMMOND *Ascent of Man*, ch. 7, p. 228. (J. P., 1900.)

1271. FOOD, ONE ARTICLE OF, UNIVERSAL—*The Value of Bread.*—If it is a fact that the kind and variety of nourishment exercise the greatest influence upon the state of health, the capacity for work and endurance, it must be of very special importance to become ac-

quainted with the dietetic value of bread. Among all nations throughout the temperate zone it is the principal means of nourishment for every one, rich as well as poor, high as well as lowly, young and old. It forms the basis of the entire nourishment; it is never wanting on the table, morning, midday, or evening; it accompanies the laborer to his work, the child to school, the traveler on his journey, and, altho eaten every day, always remains popular, is always desired.—UFFELMANN *Das Brod und dessen dietetischer Werth.* (Translated for *Scientific Side-Lights.*)

1272. FOOD, PERMANENT SUPPLY OF —*Granaries the Invention of Woman.*—There is abundant proof among the three typical divisions of humanity still living in savagery—the American Indian, the negroid races, and the Malayo-Polynesians—that women were the builders and owners of the first caches, granaries, and storehouses of provisions.—MASON *Woman's Share in Primitive Culture,* ch. 2, p. 18. (A., 1894.)

1273. FOOD RATHER THAN STIMULANT — *Sustaining Properties of Cocoa or Chocolate — A Traveler's Resource.* — Another essential difference between cocoa and tea or coffee is that cocoa is, strictly speaking, a food. We do not merely make an infusion of the cacao-bean, but eat it bodily in the form of a soup. It is highly nutritious, one of the most nutritious foods in common use. When traveling on foot in mountainous and other regions, where there was a risk of spending the night *al fresco* and supperless, I have usually carried a cake of chocolate in my knapsack, as the most portable and unchangeable form of concentrated nutriment, and have found it most valuable. On one occasion I went astray on the Kjolenfjeld, in Norway, and struggled for about twenty-four hours without food or shelter. I had no chocolate then, and sorely repented my improvidence. Many other pedestrians have tried chocolate in like manner, and all I know have commended its great "staying" properties, simply regarded as food. I therefore conclude that Linnæus was not without strong justification in giving it the name of *theobroma* (food for the gods), but to confirm this practically the pure nut, the whole nut, and nothing but the nut (excepting the milk and sugar added by the consumer) should be used. Some miserable counterfeits are offered—farinaceous paste, flavored with cocoa and sugar. The best sample I have been able to procure is the ship cocoa prepared for the navy. This is nothing but the whole nut unsweetened, ground, and crushed to an impalpable paste.—WILLIAMS *Chemistry of Cookery,* ch. 15, p. 263. (A., 1900.)

1274. FOOD, SAVORY, THE MORE NUTRITIOUS—*Bone-soup Problem—Conclusions from Experiments of French Academy—Science Increases Human Sustenance.*—The inferences drawn by M. Edwards [from the experiments of the French Academy on bone soup] are that, to render gelatin soup equal in nutritive and digestible qualities to that prepared from meat alone, it is sufficient to mix one-fourth of meat soup with three-fourths of gelatin soup; and that, in fact, no difference is perceptible between soup thus prepared and that made solely from meat; that in preparing soup in this way, the great advantage remains that while the soup itself is equally nourishing with meat soup, three-fourths of the meat which would be requisite for the latter by the common process of making soup are saved and made useful in another way—as by roasting, etc.; that jellies ought always to be associated with some other principles to render them both nutritive and digestible. A young dog that had ceased growing, and had lost one-fifth of its original weight when fed on bread and gelatin for thirty days, was next supplied with the same food, but to which was added, twice a day, only two tablespoonfuls of soup made from horseflesh. There was an increase of weight on the first day, and "in twenty-three days the dog had gained considerably more than its original weight, and was in the enjoyment of vigorous health and strength." All this difference was due to the savory constituents of the four tablespoonfuls of meat soup, which soup contained the juices of the flesh, to which, as already stated, its flavor is due.—WILLIAMS *Chemistry of Cookery,* ch. 4, p. 38. (A., 1900.)

1275. FOOD, TOXIC SUBSTANCE NOT A—*Alcohol Not Nutritious—An Undesirable Saving.*—It is therefore wholly inappropriate to speak of alcohol as fat-saving, and there is still less sense in regarding a toxic substance as food because the protoplasm it has destroyed is no longer capable of taking part in the vital processes and the oxidations associated with them. Nor is there any reason for speaking of a desirable saving, or, indeed, of a nourishing function of alcohol, if by benumbing the brain-centers it lowers the functional activity of the organs innervated by them, and thus causes a diminution of the oxidation process accompanying their activity.—KASSOWITZ *Is Alcohol a Food or a Poison?* p. 14. (Translation by MRS. J. H. W. STUCKENBERG.)

1276. FOOD, VARIETY OF, A NECESSITY—*Balance of Carbon and Nitrogen—Waste of Tissues Must Be Supplied.*—In order that life may be maintained it is necessary that the body should be supplied with food in proper quality and quantity.

The food taken in by the animal body is used for the purpose of replacing the waste of the tissues. And to arrive at a reasonable estimation of the proper diet in twenty-four hours it is necessary to consider the amount of the excreta daily eliminated from the body. The excreta contain chiefly carbon, hydrogen, oxygen, and nitrogen, but

also, to a less extent, sulfur, phosphorus, chlorin, potassium, sodium, and certain other of the elements. Since this is the case it must be evident that, to balance this waste, foods must be supplied containing all these elements to a certain degree, and some of them, viz., those which take the principal part in forming the excreta, in large amount. . . . The quantity of carbon daily lost from the body amounts to about 281.2 grams or nearly 4,500 grains, and of nitrogen 18.8 grams, or nearly 300 grains: and if a man could be fed by these elements, as such, the problem would be a very simple one; a corresponding weight of charcoal, and, allowing for the oxygen in it, of atmospheric air, would be all that is necessary. But an animal can live only upon these elements when they are arranged in a particular manner with others, in the form of an organic compound, as albumin, starch, and the like; and the relative proportion of carbon to nitrogen in either of these compounds alone is, by no means, the proportion required in the diet of man. Thus, in albumin the proportion of carbon to nitrogen is only as 3.5 to 1. If, therefore, a man took into his body, as food, sufficient albumin to supply him with the needful amount of carbon, he would receive more than four times as much nitrogen as he wanted; and if he took only sufficient to supply him with nitrogen, he would be starved for want of carbon. It is plain, therefore, that he should take with the albuminous part of his food, which contains so large a relative amount of nitrogen in proportion to the carbon he needs, substances in which the nitrogen exists in much smaller quantities relatively to the carbon.

It is therefore evident that the diet must consist of several substances, not of one alone, and we must therefore turn to the available food-stuffs.—BAKER *Handbook of Physiology*, vol. i, ch. 7, p. 212. (W. W., 1885.)

1277. FOODS, ADULTERATION OF—*The Perversion of Science—Injurious or Dangerous Preservatives.*—In the adulteration of foods, unfortunately, the fraud is not always confined to matters harmless to health. Bad as any adulteration of an article of food or drink may be, it is not of the highest class of criminality when the fraudulent practises consist in the addition of harmless substances, but the health of the consumer becomes endangered when adulterations assume a poisonous character or are of a nature which by constant use will produce disturbances in the vital functions. Many bodies which have poisonous qualities are often introduced into foods either for the purpose of preserving them or of adding to the attractiveness of their appearance. Among preservatives which are commonly found, and which may be regarded as injurious, may be mentioned sulfurous and salicylic acids and borax. These bodies, when taken in minute quantities and for short intervals of time, produce no deleterious effects whatever. When, however, they are used for an indefinite period, they tend to derange the digestive organs and impair health. . . . The seemingly natural red color of preserved meats is secured by the use of niter and other similar objectionable agents.—WILEY *Relations of Chemistry to Industrial Progress (Address at Purdue University, Lafayette, Ind., 1896*, p. 42).

1278. FOODS, NUTRITIVE VALUE OF—*Advantage of Scientific Analysis—Benefit to Animals and Man.*—In the matter of foods the chemist has also made investigations in another direction which are of the utmost importance to industrial progress. He has investigated, first, from a purely scientific basis, the problems of nutrition. He has shown that certain characters of foods in the animal economy tend to produce certain results, and as a result of these investigations is able to prepare a ration which in any given case will meet the requirements desired. The pig which is fed for market requires quite a different ratio in the ingredients of its food-principles from the cow that is fed for milk or butter. Three great food-principles are recognized, viz., fats, carbohydrates, and proteids. It is possible, by a judicious combination of these great food-principles, to produce in any given case a ration which will secure the effect desired in the most economical way. By following rigidly the principles which have thus been established by scientific research, it is possible at the present day to prepare a hundred pounds of pork for market at a cost fully one-third less than was required by the haphazard method pursued a quarter of a century ago. . . . Wider fields of utility, however, open up before the possibilities of chemical investigation in the matter of human foods. If pigs deserve to be fed on balanced rations, and steers stand in wait for the mandates of science before they chew their cuds, it is not too much to ask that man himself should receive some consideration.—WILEY *Relations of Chemistry to Industrial Progress (Address at Purdue University, Lafayette, Ind., 1896*, p. 44).

1279. FOODS, THE CHEMISTRY OF—*The Body Heated Like a Stove.*—The food of man and animals consists of two classes of substance differing essentially in composition. The one class (consisting of nitrogenous substances, albumin, etc.) serves in the formation of blood and in building up the various organs of the body; this is called plastic food. The other (consisting of non-nitrogenous substances, the fatty bodies, and the so-called carbohydrates) resembles ordinary fuel and serves in the generation of heat; this is designated by the term respiratory food. Sugar, starch, or gum may be looked upon as modified woody fiber, from which it is known that they are capable of being formed. Fat, from the

quantity of carbon it contains, stands nearest to coal. We heat our bodies precisely as we heat a stove, with fuel that contains the same elements as wood and coal, but differs essentially from the latter substances in being soluble in the juices of the body.—LIEBIG *Ueber die Verwandlung der Kräfte (Sammlung wissenschaftlicher Vorträge, gehalten zu München, 1858*, p. 594). (Translated for *Scientific Side-Lights.)*

1280. FORCE A REFLECTION OF MAN'S CONSCIOUS EFFORT—If we trace all our conceptions on the nature of force to their fountain-head, we shall find that they are formed on our own consciousness of living effort—of that force which has its seat in our own vitality, and especially on that kind of it which can be called forth at the bidding of the will.—ARGYLL *Reign of Law*, ch. 2, p. 72. (Burt.)

1281. FORCE, ATOMIC, EXCEEDS GRAVITATION—*Energy Required to Heat a Pound Would Lift Tons.*—As measured by any ordinary mechanical standard, the magnitude of the forces engaged in this atomic motion and interior work is enormous. A pound of iron, on being heated from 0° C. to 100° C., expands by about $\frac{1}{300}$th of the volume which it possesses at 0°. Its augmentation would certainly escape the most acute eye; still, to give its atoms the motions corresponding to this increase of temperature, and to shift them through the small space indicated, an amount of heat is requisite which would raise a weight of about eight tons one foot high. The force of gravity almost vanishes in comparison with these molecular forces; the pull of the earth upon our pound weight, as a mass, is as nothing compared with the mutual pull of its own atoms.—TYNDALL *Heat a Mode of Motion*, lect. 7, p. 185. (A., 1900.)

1282. FORCE, BRUTE, AT HIGHEST POINT ERE MAN APPEARS—*Human Intelligence Conquers—Giant Mammals Become Extinct.*—The earlier mammalia were giants in comparison with those now living. The mastodon and mammoth as compared with the modern elephant, the megatherium as compared with the sloth or ant-eaters of present times, the hyenas and bears of the European caverns, and the fossil elk of Ireland, by the side of which even the moose of our Northern woods is belittled, are remarkable instances in proof of this. One cannot but be struck with the fact that this first representation of mammalia, the very impersonation of brute force in power, size, and ferocity, immediately preceded the introduction of man, with whose creation intelligence and moral strength became the dominant influences on earth.—AGASSIZ *Geological Sketches*, ser. i, ch. 7, p. 195. (H. M. & Co., 1896.)

1283. FORCE, ELECTRICAL—*Faraday's Discovery—Marvelous Applications within Fifty Years.*—It is only a little over half a century since Faraday made his discovery [of the production of an electrical current by the movement of a conducting body in a magnetic field]. As a result of this observation, so apparently unimportant, we see to-day an entirely new curriculum of study in all of our great schools. The science of electrical engineering is a direct outgrowth of Faraday's observation. We have seen already a complete revolution in the methods of transporting passengers in cities, growing out of this discovery. Rapidly are coming changes in the transmission of energy and in the utilization of the waste forces of Nature. Torrents and cataracts are made to do valuable work for humanity hundreds of miles from their localities. A new system of illumination has sprung up over the whole civilized world, displacing oil and gas. It requires no prophet to foresee the day when the development of electrical energy made possible by Faraday's discovery will be accomplished far more economically than at the present, perhaps even permitting the direct conversion of burning fuel into electrical force. . . . Could there be a more striking illustration of what a discovery in pure science, developed by skilful technologists, can do in the promotion of human industry?—WILEY *Relations of Chemistry to Industrial Progress (Address at Purdue University, Lafayette, Ind., 1896*, p. 21).

1284. FORCE, ENORMOUS, OF CHEMICAL COMBINATION—*Measured in Terms of Falling Body.*—It has been stated that when a body falls to the earth it is warmed by the shock. Here, to use the terminology of Mayer, we have a mechanical combination of the earth and the body. Let us suffer the falling body and the earth to dwindle in imagination to the size of atoms, and for the attraction of gravity let us substitute that of chemical affinity; we have then what is called a chemical combination. The effect of the union in this case also is the development of heat, and from the amount of heat generated we can infer the intensity of the atomic pull. Measured by ordinary mechanical standards, this is enormous. Mix eight pounds of oxygen with one of hydrogen, and pass a spark through the mixture: the gases instantly combine, their atoms rushing over the little distances which separate them. Take a weight of 47,000 pounds to an elevation of 1,000 feet above the earth's surface, and let it fall: the energy with which it will strike the earth will not exceed that of the eight pounds of oxygen atoms as they dash against one pound of hydrogen atoms to form water.—TYNDALL *Fragments of Science*, vol. i, ch. 1, p. 10. (A., 1897.)

1285. FORCE EXPENDED TO CONVERT WATER INTO STEAM—In order to pull apart the molecules of a pound of water, that is, convert it into steam, we must exert a mechanical power which is

the equivalent of 822,600 foot-pounds; that is, a power which would raise nearly four tons to the height of one hundred feet.—COOKE *New Chemistry*, lect. 1, p. 25. (A., 1899.)

1286. FORCE, FIELD OF, ABOUT A MAGNET—*Iron-filings Supposed Raving to Escape.*—Even more remarkable than this is his [Lucretius's] statement that iron-filings "will rave within brass basins" when the stone is placed beneath. This was the first perception of the field of force about a magnet, by noting not merely the effect of its attraction or repulsion exerted upon the pole of another magnet brought into it, but upon loose iron-filings free to dispose themselves therein along the lines of force. Then, under the astonished gaze of the poet, the particles of metal arranged themselves in the curious curves of the magnetic spectrum, and rose like bristles in front of the poles. And as he moved the stone beneath the brass basin which held them, he saw them fly from one side of it to the other, sometimes grouping themselves for an instant in dense bunches, then leaping apart and scattering all so incoherently and so wildly that it is small wonder that he regarded them as raving in their frantic desire to break away from the mysterious force.—PARK BENJAMIN *Intellectual Rise in Electricity*, ch. 2, p. 50. (J. W., 1898.)

1287. FORCE, LIVING, OF MOVING BODIES—*Vis Viva—Increase as Square of Velocity.*—In mechanics, the product of the mass of a moving body into the square of its velocity expresses what is called the *vis viva*, or living force. It is also sometimes called the "mechanical effect." If, for example, a cannon pointed to the zenith urge a ball upwards with twice the velocity imparted to a second ball, the former will rise to four times the height attained by the latter. If directed against a target, it will also do four times the execution. Hence the importance of imparting a high velocity to projectiles in war.—TYNDALL *Fragments of Science*, vol. i, ch. 1, p. 15. (A., 1897.)

1288. FORCE, MAGNETIC, LINES OF—*Iron-filings Grouped around Poles of Magnet.*—Placing a sheet of paper or glass over a bar magnet and showering iron-filings upon the paper, I notice a tendency of the filings to arrange themselves in determinate lines. They cannot freely follow this tendency, for they are hampered by the friction against the paper. They are helped by tapping the paper; each tap releasing them for a moment, and enabling them to follow their tendencies. . . . The aspect of these curves so fascinated Faraday that the greater portion of his intellectual life was devoted to pondering over them. He invested the space through which they run with a kind of materiality; and the probability is that the progress of science, by connecting the phenomena of magnetism with the luminiferous ether, will prove these "lines of force," as Faraday loved to call them, to represent a condition of this mysterious substratum of all radiant action.—TYNDALL *Lectures on Light*, lect. 3, p. 98. (A., 1898.)

1289. FORCE, MAN UTILIZES, BUT DOES NOT CREATE—*Property in Forces—Wind and Stream.*—We cannot create mechanical force, but we may help ourselves from the great storehouse of Nature. The brook and the wind which drive our mills, the forest and the coal-bed which supply our steam-engines and warm our rooms, are to us the bearers of a small proportion of the great natural supply which we draw upon for our purposes, and the action of which we can apply as we see fit. The possessor of a mill claims the gravity of the descending rivulet or the living force of a moving wind as his possession. These portions of the store of Nature are what give his property its chief value.—HELMHOLTZ *Interaction of Natural Forces*, p. 227. (Translated for *Scientific Side-Lights.*)

1290. FORCE MISAPPLIED—*Lubrication Converges Power on Work.*—So also with regard to the greasing of a saw by a carpenter. He applies his force with the express object of cutting through the wood. He wishes to overcome mechanical cohesion by the teeth of his saw, and, when it moves stiffly, the same amount of effort may produce a much smaller effect than when the implement moves without friction. But in what sense smaller? Not absolutely so, but smaller as regards the act of sawing. The force not expended in sawing is misapplied, not lost; it is converted into heat. Here again, if we could collect the heat engendered by the friction, and apply it to the urging of the saw, we should make good the precise amount of work which the carpenter, by neglecting the lubrication of his implement, had simply converted into another form of power.—TYNDALL *Heat a Mode of Motion*, lect. 1, p. 9. (A., 1900.)

1291. FORCE OF CRYSTALLIZATION—*Wonderful Property of Lifeless Matter.*—Gravitation . . . consists of an attraction of every particle of matter for every other particle. You know that planets and moons are held in their orbits by this attraction. But gravitation is a very simple affair compared to the force, or rather forces, of crystallization. For here the ultimate particles of matter, inconceivably small as they are, show themselves possessed of attractive and repellent poles, by the mutual action of which the shape and structure of the crystal are determined. In the solid condition the attracting poles are rigidly locked together; but if sufficient heat be applied the bond of union is dissolved, and in the state of fusion the poles are pushed so far asunder as to be practically out of each other's range. The natural tendency of the molecules to build themselves together is thus neutralized. This is the case with

water, which as a liquid is to all appearance formless. When sufficiently cooled the molecules are brought within the play of the crystallizing force, and they then arrange themselves in forms of indescribable beauty. —TYNDALL *Forms of Water,* § 88, p. 30. (A., 1899.)

1292. FORCE OF EXPANSION RESISTLESS—*Freezing Water Shatters Iron.*—The force with which water expands in freezing is all but irresistible. With the view of giving you an illustration of this fact, water has been confined in this iron bottle which is fully half an inch thick; the quantity of water being small, tho sufficient to fill the bottle. The bottle is closed by a screw firmly fixed in its neck. Two bottles thus prepared are placed in a copper vessel, and surrounded with a freezing mixture. They cool gradually, the water within them approaching its point of maximum density. No doubt, at this moment, a small vacuous space exists within each bottle. But soon the contraction ceases, and expansion sets in. The vacuous space is slowly filled, the water gradually changes from liquid to solid. To accomplish this change it requires more room, which the rigid iron refuses to grant. But its rigidity is powerless in the presence of these molecular forces, and the sound you now hear indicates that the bottle is shivered by the crystallizing molecules. The other bottle follows; and here are the fragments of the vessels, showing their thickness, and impressing you with the vastness of the expansive force by which they have been thus riven. While I have been speaking, you have heard a louder explosion in front of the table. That was due to the rupture of a thick bombshell kindly prepared for me at Woolwich by Professor Abel. It was filled with water, screwed up tight, placed in a bucket, and surrounded by a freezing mixture. Taken from the mixture, the fragments of the bomb are placed here before you. Care must be taken in repeating this experiment to cover the bucket with a thick cloth. Wanting such protection I have seen the stopper of a broken bomb projected nearly as high as this ceiling.—TYNDALL *Heat a Mode of Motion,* lect. 4, p. 105. (A., 1900.)

1293. FORCE OF GRAVITY AT THE SUN'S SURFACE—The sun attracts objects at its surface twenty-seven times more strongly than the earth does. This calculation would be the same for the investigation of gravity at the surface of all the planets. A human body, if it could be transported to the sun, would be immediately flattened by gravity into a thin leaf. But, in point of fact, it would be vaporized long before it could arrive there.—FLAMMARION *Popular Astronomy,* bk. iii, ch. 2, p. 242. (A.)

1294. ——— ——— *All Earthly Adjustments Changed.*—If we calculate the force of gravity at the sun's surface, which is easily done by dividing its mass, 330,000, by the square of 109½ (the number of times the sun's diameter exceeds the earth's), we find it to be 27½ times as great as on the earth; a man who on the earth would weigh 150 pounds would there weigh nearly two tons; and, even if the footing were good, would be unable to stir. A body which at the earth falls a little more than 16 feet in a second would there fall 443. A pendulum which here swings once a second would there oscillate more than five times as rapidly, like the balance-wheel of a watch—quivering rather than swinging.—YOUNG *The Sun,* ch. 1, p. 41. (A., 1898.)

1295. FORCE OF RUNNING WATER—*Sand and Pebbles Give Cutting Power.*—The mechanical force exerted by running water in undermining cliffs and rounding off the angles of hard rock is mainly due to the intermixture of foreign ingredients. Sand and pebbles, when hurried along by the violence of the stream, are thrown against every obstacle lying in their way, and thus a power of attrition is acquired, capable of wearing through the hardest silicious stones, on which water alone could make no impression.—LYELL *Geology,* ch. 14, p. 204. (A., 1854.)

1296. FORCE, ORIGIN AND EXTENSION OF IDEA OF—*Power an Essential Element of Causation.*—When, however, we not only look at bodies in motion, but try to resist their motion by an exertion of our own, or use a similar exertion in giving motion to a body at rest, we are led, by our own sense of effort in making it, to an entirely new conception, that of force; and no advance in the philosophy of science has been greater than that which has of late years extended the notion of force, from the agency which produces or resists the motion of masses, to the agencies which are concerned in producing the molecular changes which we refer to heat, light, electricity, magnetism, etc. The man of science of the present day is thus enabled to attach a distinct idea to that efficient causation which logicians have continually denied, but which the common sense of mankind has universally recognized. When the cause of any event is spoken of, in common parlance, we certainly attach to the term the idea of power, at the same time that we include the notion of the conditions under which that power operates; and this view of the case can be shown to be scientifically correct.—CARPENTER *Mental Physiology,* ch. 20, p. 693. (A., 1900.)

1297. FORCE, THE DIRECTION OF—*Importance of Initiative—Early Metallurgy—Heat-engines.*—When a savage softened or melted a lump of copper in a blaze, his act was one of direction rather than of execution: to have warmed the metal by repeated blows would have been a toilsome and unrewarded task; while to place the copper in the flame and duly to remove it

was labor of an unexacting and most fruitful kind. So, too, when heat-engines of constantly improved types came into the mines, the shops, and factories of the world, and were last of all adapted to transportation, the work that a skilful man could direct became immensely greater and bolder than the task he could perform by dint of exerting his own muscles. In this passing to more and more of initiative consists an important phase of civilization.—ILES *Flame, Electricity, and the Camera*, ch. 5, p. 63. (D. & McC., 1900.)

1298. FORCES, ELEMENTAL, MADE TO WORK FOR MAN—*Transformation of Industry—From Shadoof to Water-wheel.*—In the period of ancient civilization there appear the beginnings of that immense change which is remodeling modern life, by inventions which set the forces of Nature to do man's heavy work for him. This great change seems to have been especially brought on by contrivances to save the heavy toil of watering the fields. A simple hand-labor contrivance of this kind is the shadoof of the Nile Valley, where a long pole with a counterpoise at one end is supported on posts, and carries a bucket hanging to the longer end to dip up water from below. . . . For irrigation, it was mechanically an improvement on this to set a gang of slaves to turn a great wheel with buckets or earthern jars at its circumference, which rose full from the water below, and as they turned over emptied themselves into a trough at a higher level. But when such a wheel was built to dip in a running stream, then the current itself would turn the wheel, and thus would come into existence the noria, or irrigating water-wheel, often mentioned in ancient literature, and to be seen still at work both in the East and in Europe. By these or some similar steps of invention the water-wheel was made a source of power for doing other work, such as grinding corn, instead of the women at the quern or the slaves at the treadmill, or the mill-horse in his everlasting round. As the Greek epigram says, "Cease your work, ye maids who labored at the mills, sleep and let the birds sing to the returning dawn, for Demeter has bidden the water-nymphs to do your task; obedient to her call, they throw themselves on the wheel and turn the axle and the heavy mill."—TYLOR *Anthropology*, ch. 8, p. 203. (A., 1899.)

1299. FORCES, MATERIAL AND MENTAL—*Every Force Perhaps a Manifestation of Will.*—Undoubtedly the first thought which suggests itself to the mind is, that a material force and a moral or intellectual force are essentially different in kind—not subject to conditions the same, or even similar. But are we sure of this? Are we sure that the forces which we call material are not, after all, but manifestations of mental energy and will? We have already seen that such evidence as we have is all tending the other way. The conclusions forced upon us have been these: First, that the more we know of Nature the more certain it appears that a multiplicity of separate forces does not exist, but that all her forces pass into each other, and are but modifications of some one force which is the source and center of the rest; secondly, that all of them are governed in their mutual relations by principles of arrangement which are purely mental; thirdly, that of the ultimate seat of force in any form we know nothing directly; and fourthly, that the nearest conception we can ever have of force is derived from our own consciousness of vital power.—ARGYLL *Reign of Law*, ch. 6, p. 164. (Burt.)

1300. FORCES OF NATURE NOT BLIND—*The Blindness Is in Man—Snow-crystals.*—When snow is produced in calm air, the icy particles build themselves into beautiful stellar shapes, each star possessing six rays. There is no deviation from this type, tho in other respects the appearances of the snow-stars are infinitely various. . . . It is worth pausing to think what wonderful work is going on in the atmosphere during the formation and descent of every snow-shower: what building power is brought into play! and how imperfect seem the productions of human minds and hands when compared with those formed by the blind forces of Nature!

But who ventures to call the forces of Nature blind? In reality, when we speak thus, we are describing our own condition. The blindness is ours; and what we really ought to say, and to confess, is that our powers are absolutely unable to comprehend the origin or the end of the operations of Nature.—TYNDALL *Forms of Water*, § 89, p. 31. (A., 1899.)

1301. FORCES, TITANIC, OF NATURE—*Rocks Ground to Impalpable Powder.*—During their upward discharge and downward fall, the cindery fragments are by attrition continually reduced to smaller dimensions. The noise made by these fragments, as they strike against one another in the air during their rise and fall, is one of the most noteworthy accompaniments of volcanic eruptions. It has been noticed that in many cases there is a constant diminution in the size of the fragments ejected during a volcanic outburst, this being doubtless due to the friction of the masses as they are ejected and reejected from the vent. Thus it is related by Mr. Poulett Scrope, who watched the Vesuvian eruption of 1822, which lasted for nearly a month, that during the earlier stages of the outburst fragments of enormous size were thrown out of the crater, but by constant reejection these were gradually reduced in size, till at last only the most impalpable dust issued from the vent. This dust filled the atmosphere, producing in the city of Naples "a darkness that might be felt,"

and so excessively finely divided was it that it penetrated into all drawers, boxes, and the most closely fastened receptacles, filling them completely.—JUDD *Volcanoes*, ch. 4, p. 68. (A., 1899.)

1302. FORCES UNSEEN IN THE AIR WE BREATHE—*Mountains Precipitate Invisible Vapor.*—The atmospheric change [after crossing the Simplon to the Italian lakes] was wonderful; and still the clear air which we enjoyed below was the selfsame air that heaped clouds and snow upon the mountains. It came across the heated plains of Lombardy charged with moisture, but the moisture was in the transparent condition of true vapor, and hence invisible. Tilted by the mountains, the air rose, and as it expanded it became chilled, and as it became chilled it discharged its vapor as visible cloud, the globules of which swelled by coalescence into raindrops on the mountain flanks, or were frozen to snow upon the mountain.—TYNDALL *Hours of Exercise in the Alps*, ch. 22, p. 261. (A., 1898.)

1303. FORCES, UNSEEN, POWER OF—*Bonds of Wire or Steel to Equal Sun's Attraction.*—As for the attraction between the sun and earth, it amounts to thirty-six hundred quadrillions of tons: in figures, 36 followed by seventeen ciphers. On this point we borrow an impressive illustration from a careful calculation by Mr. C. B. Warring. We may imagine gravitation to cease, and to be replaced by a material bond of some sort, holding the earth to the sun and keeping her in her orbit. If now we suppose this connection to consist of a web of steel wires, each as large as the heaviest telegraph-wires used, then to replace the sun's attraction these wires would have to cover the whole sunward hemisphere of our globe about as thickly as blades of grass upon a lawn. It would require nine to each square inch. Putting it a little differently, the attraction between the sun and earth is equal to the breaking strain of a steel rod about 3,000 miles in diameter.—YOUNG *The Sun*, ch. 1, p. 41. (A., 1898.)

1304. FORCES, VITAL AND MATERIAL—*Terms Ill-understood.*—What is a vital force? It is something which we cannot see, but of whose existence we are as certain as we are of its visible effects—nay, which our reason tells us precedes and is superior to these. We often speak of material forces as if we could identify any kind of force with matter. But this is only one of the many ambiguities of language. All that we mean by a material force is a force which acts upon matter, and produces in matter its own appropriate effects. We must go a step further, therefore, and ask ourselves, what is force? What is our conception of it? What idea can we form, for example, of the real nature of that force the measure of whose operation has been so exactly ascertained—the force of gravitation? It is invisible—imponderable—all our words for it are but circumlocutions to express its phenomena or effects.—ARGYLL *Reign of Law*, ch. 2, p. 71. (Burt.)

1305. FORCES WORKING IN UNISON—*Light, Heat, and Electricity Inseparably Connected with Motion and Life.*—Light, and radiating heat, which is inseparable from it, constitute a main cause of motion and organic life, both in the non-luminous celestial bodies and on the surface of our planet. Even far from its surface, in the interior of the earth's crust, penetrating heat calls forth electromagnetic currents, which exert their exciting influence on the combinations and decompositions of matter—on all formative agencies in the mineral kingdom—on the disturbance of the equilibrium of the atmosphere—and on the functions of vegetable and animal organisms. If electricity moving in currents develops magnetic forces, and if, in accordance with an early hypothesis of Sir William Herschel, the sun itself is in the condition of "a perpetual northern light" (I should rather say of an electromagnetic storm), we should seem warranted in concluding that solar light, transmitted in the regions of space by vibrations of ether, may be accompanied by electromagnetic currents.—HUMBOLDT *Cosmos*, vol. iii, p. 34. (H., 1897.)

1306. FOREST, PRIMEVAL—*Brazil—Terra del Fuego—Silent Message of the God of Nature.*—Among the scenes which are deeply impressed on my mind, none exceed in sublimity the primeval forests undefaced by the hand of man; whether those of Brazil, where the powers of life are predominant, or those of Terra del Fuego, where death and decay prevail. Both are temples filled with the varied productions of the God of Nature—no one can stand in these solitudes unmoved, and not feel that there is more in man than the mere breath of his body.—DARWIN *Naturalist's Voyage around the World*, ch. 21, p. 503. (A., 1898.)

1307. FORESTS BURIED UNDER DRIFT—*The Elephant, Rhinoceros, and Hippopotamus Once Ranged in England.*—At one of the most charming spots on the coast of Norfolk, Cromer, you will see the boulder-clay forming a vast mass, which lies upon the chalk, and must consequently have come into existence after it. I have spoken of the boulder-clay and drift as resting upon the chalk. That is not strictly true. Interposed between the chalk and the drift is a layer containing vegetable matter. But that layer tells a wonderful history. It is full of stumps of trees standing as they grew. Fir-trees are there with their cones, and hazel-bushes with their nuts; there stand the stools of oak- and yew-trees, beeches and alders. Hence this stratum is appropriately called the "forest-bed."

It is obvious that the chalk must have been upheaved and converted into dry land before the timber trees could grow upon it.

As the boles of some of these trees are from two to three feet in diameter, it is no less clear that the dry land thus formed remained in the same condition for long ages. And not only do the remains of stately oaks and well-grown firs testify to the duration of this condition of things, but additional evidence to the same effect is afforded by the abundant remains of elephants, rhinoceroses, hippopotamuses, and other great wild beasts.—HUXLEY *Lay Sermons,* serm. 9, p. 193. (G. P. P., 1899.)

1308. FORESTS BURIED UNDER ICE —*Return after Centuries to the Sunlight.*—The glacier, now in its full strength, advances from the extremity of the valley that sheltered its youth and guided its early life, and invades the piedmont plain. The low lands are densely forested. Majestic spruce-trees and aged moss-covered hemlocks stand in thick, serrate ranks across the glacier's path, but are mowed down as easily as the grass before a scythe. Crushed, broken, and splintered, the trunks are piled in huge confused heaps and overriden and buried by the slow but resistless march of the ice. Where the waters flowing from the glacier are abundantly loaded with sand and gravel, they build alluvial deposits about its margin. The streams in their passage over these alluvial cones subdivide and send off distributaries into the forest to the right and left, and the trees are surrounded and buried by sand and gravel while yet standing. A fringe of dead trees, in part denuded of their branches, marks the areas where the stream-borne deposits have made recent conquests. Under these conditions the glacier advances over the buried forests, and all vestiges of its existence are blotted out. Centuries later the still erect trunks may be revealed [as now at Muir Glacier, Alaska].—RUSSELL *Glaciers of North America,* ch. 10, p. 199. (G. & Co., 1897.)

1309. FORESTS BURIED UNDER STRATA—*Gradual Subsidence of Earth's Crust.*—The supposition of a gradual subsidence over large areas is by no means improbable. We have the clearest proof that a movement of this kind is possible, in the upright trees buried under strata many thousand feet in thickness; we have also every reason for believing that there are now large areas gradually sinking, in the same manner as others are rising. And when we consider how many parts of the surface of the globe have been elevated within recent geological periods, we must admit that there have been subsidences on a corresponding scale, for otherwise the whole globe would have swollen. It is very remarkable that Sir C. Lyell, even in the first edition of his "Principles of Geology," inferred that the amount of subsidence in the Pacific must have exceeded that of elevation, from the area of land being very small relatively to the agents there tending to form it, namely the growth of coral and volcanic action.—DARWIN *Coral Reefs,* ch. 5, p. 128. (A., 1900.)

1310. FORGETFULNESS, HUMAN—*Changes in Earth Unrecorded—A Moslem Parable.*—A manuscript work, entitled the "Wonders of Nature," is preserved in the Royal Library at Paris, by an Arabian writer, Mohammed Kazwini, who flourished in the seventh century of the Hegira, or at the close of the thirteenth century of our era. Besides several curious remarks on aerolites, earthquakes, and the successive changes of position which the land and sea have undergone, we meet with the following beautiful passage which is given as the narrative of Kidhz, an allegorical personage: "I passed one day by a very ancient and wonderfully populous city, and asked one of its inhabitants how long it had been founded. 'It is indeed a mighty city,' replied he; 'we know not how long it has existed, and our ancestors were on this subject as ignorant as ourselves.' Five centuries afterwards, as I passed by the same place, I could not perceive the slightest vestige of the city. I demanded of a peasant, who was gathering herbs upon its former site, how long it had been destroyed. 'In sooth a strange question!' replied he. 'The ground here has never been different from what you now behold it.' 'Was there not of old,' said I, 'a splendid city here?' 'Never,' answered he, 'so far as we have seen, and never did our fathers speak to us of any such.' On my return there, 500 years afterwards, I found the sea in the same place, and on its shores were a party of fishermen, of whom I inquired how long the land had been covered by the waters. 'Is this a question,' said they, 'for a man like you? This spot has always been what it is now.' I again returned 500 years afterwards, and the sea had disappeared; I inquired of a man who stood alone upon the spot, how long ago this change had taken place, and he gave me the same answer as I had received before. Lastly, on coming back again after an equal lapse of time, I found there a flourishing city, more populous and more rich in beautiful buildings than the city I had seen the first time, and when I would fain have informed myself concerning its origin, the inhabitants answered me, 'Its rise is lost in remote antiquity; we are ignorant how long it has existed, and our fathers were on this subject as ignorant as ourselves.'"—LYELL *Principles of Geology,* bk. i, ch. 3, p. 19. (A., 1854.)

1311. FORMATION OF ROCKS IN THE PRESENT ERA—*Nature Seen at Work.*—Some of the springs which issue from the ichthyolite beds along the shores of the Moray Frith are largely charged, not with iron, . . . but with carbonate of lime. When employed for domestic purposes, they choke up, in a few years, with a stony deposition, the spouts of tea-kettles. On a

similar principle, they plug up their older channels, and then burst out in new ones; nor is it uncommon to find among the cliffs little hollow recesses, long since divested of their waters by this process, that are still thickly surrounded by coral-like incrustations of moss and lichens, grass and nettle-stalks, and roofed with marble-like stalactites. I am acquainted with at least one of these springs of very considerable volume, and dedicated of old to an obscure Roman Catholic saint, whose name it still bears (St. Bennet), which presents phenomena not unworthy the attention of the young geologist. It comes gushing from out the ichthyolite bed, where the latter extends, in the neighborhood of Cromarty, along the shores of the Moray Frith: and after depositing in a stagnant morass an accumulation of a grayish-colored and partially consolidated travertin, escapes by two openings to the shore, where it is absorbed among the sand and gravel. A storm about three years ago swept the beach several feet beneath its ordinary level, and two little moles of conglomerate and sandstone, the work of the spring, were found to occupy the two openings. Each had its fossils—comminuted sea-shells and stalks of hardened moss; and in one of the moles I found embedded a few of the vertebral joints of a sheep. It was a recent formation on a small scale, bound together by a calcareous cement furnished by the fish-beds of the inferior Old Red Sandstone, and composed of sand and pebbles, mostly from the granitic gneiss of the neighboring hill, and organisms, vegetable and animal, from both the land and the sea.—MILLER *Old Red Sandstone*, ch. 10, p. 184. (G. & L., 1851.)

1312. FORMATION OF SCIENTIFIC THEORIES—*Mind Demands a Cause.*—Scientific theories, in the first place, take their rise in the desire of the mind to penetrate to the sources of phenomena. From its infinitesimal beginnings, in ages long past, this desire has grown and strengthened into an imperious demand of man's intellectual nature. It long ago prompted Cæsar to say that he would exchange his victories for a glimpse of the sources of the Nile: it wrought itself into the atomic theories of Lucretius; it impels Darwin to those daring speculations which of late years have so agitated the public mind. But in no case in framing theories does the imagination create its materials. It expands, diminishes, molds, and refines, as the case may be, materials derived from the world of fact and observation.—TYNDALL *Lectures on Light*, lect. 3, p. 95. (A., 1898.)

1313. FORMATION OF WATER FROM GAS—*Mechanics of Explosion—Speed of Sound.*—Let us fill a soap-bubble with oxygen and hydrogen gases in the proportion of two parts of hydrogen to one of oxygen. If we ignite it the result will be an explosion. When the ignition takes place there is a sudden generation of heat, which suddenly expands the air, causing it to be highly rarefied at the point of explosion. The air immediately surrounding it is driven violently outward in every direction. The first layer of air-particles, surrounding the bubble, is driven against the second, and then swings back to its place, for the force that drove it outward is no longer present. The second layer swings against the third, and the third against the fourth, and so on; each layer after making its excursion outward returns to its original position. The air-particles are not fired at the ear as from a gun; they simply vibrate to and fro. The sound-pulse moves outward like an expanding globe at the rate of about 1,100 feet per second in air, the speed depending upon the medium through which it travels.—ELISHA GRAY *Nature's Miracles*, vol. ii, ch. 6, p. 59. (F. H. & H., 1900.)

1314. FORMS OF LIFE LOST AND REINTRODUCED—*Remains of Extinct Race of Horses in South America.*—In the pampean deposit at the Bajada [Entre Rios, South America] I found . . . [with remains of the mastodon, etc.] also one tooth of a horse, in the same stained and decayed state. This latter tooth greatly interested me, and I took scrupulous care in ascertaining that it had been embedded contemporaneously with the other remains; for I was not then aware that amongst the fossils from Bahia Blanca there was a horse's tooth hidden in the matrix: nor was it then known with certainty that the remains of horses are common in North America. Mr. Lyell has lately brought from the United States a tooth of a horse; and it is an interesting fact that Professor Owen could find in no species, either fossil or recent, a slight but peculiar curvature characterizing it, until he thought of comparing it with my specimen found here: he has named this American horse *Equus curvidens*. There is good evidence against any horse living in America at the time of Columbus. Certainly it is a marvelous fact in the history of the mammalia, that in South America a native horse should have lived and disappeared, to be succeeded in after-ages by the countless herds descended from the few introduced with the Spanish colonists!—DARWIN *Naturalist's Voyage around the World*, ch. 7, p. 130. (A., 1898.)

1315. FORMS OF LIFE, SEEMINGLY INDEPENDENT, IN THE BLOOD—*White Cells [Leucocytes] Battling with Germs of Disease.*—We possess in our blood millions of little living bodies, which are, in a sense, independent of us—autonomous subjects, as it were, of the body at large. They are not under our control in any sense, but live and move, and discharge their duties as freely as if they recognized no right or title of their possessor to question their acts. . . . Watching one of these living particles on a microscope slide especially kept at the

blood's own temperature, we can see it literally to flow from one shape to another. It imitates in this way the movements of many an animalcule in the pools. We may also see our independent white corpuscle seizing and digesting food-particles, as if, in very truth, it were an independent animalcule. This power of feeding, we shall see, is an important characteristic of our wandering particle. . . . For it is now a matter of certainty that among all the servants of our bodies we possess none more active, none more faithful, and none more necessary than our wandering cells. . . . There is a battle between our white cells [leucocytes] and the germs of disease. If the latter are victorious, we fall ill of the fever or other ailment; if we escape the fever, our immunity is due to the victory of our microscopic friends over the germs.—WILSON *Glimpses of Nature*, ch. 23, p. 74. (Hum., 1892.)

1316. FOSSILS AS MEMENTOES OF THE PAST—*Surpass Coins and Medals in Interest.*—"However trivial a thing," he [Robert Hooke, 1688] says, "a rotten shell may appear to some, yet these monuments of Nature are more certain tokens of antiquity than coins or medals, since the best of those may be counterfeited or made by art and design, as may also books, manuscripts, and inscriptions, as all the learned are now sufficiently satisfied has often been actually practised," etc.; "and tho it must be granted that it is very difficult to read them (the records of Nature) and to raise a chronology out of them, and to state the intervals of the time wherein such or such catastrophes and mutations have happened, yet it is not impossible."—LYELL *Principles of Geology*, pt. i, ch. 3, p. 27. (A., 1854.)

1317. FOSSILS, MAGICAL VIRTUES ATTRIBUTED TO—*"Unicorn's Horn"—Human Remains in Ancient Caves—Man Contemporary with Extinct Animals.*—The existence of fossil remains of animals in the caves of Europe has long been known. In the sixteenth and seventeenth centuries they were, under the name of "*ebur fossile*," or unicorn's horn, greatly esteemed as a medicine, and were obtained in great quantity from the caves of the Hartz district and of Hungary and Franconia. Baumann's Hole in the Hartz had already become famous at the close of the seventeenth century, and descriptions of other caves and of their contents followed at intervals, until at last a new branch of investigation sprang up, the importance of which can hardly be exaggerated when its bearings upon the early history of man are considered. It was long, however, before the possibility of man's existence contemporaneously with the extinct animals found in some of the oldest caves was entertained by the majority of scientific men; but the doubt was finally set at rest in 1858 upon the discovery of undoubted human relics in the celebrated Brixham Cave in Devonshire.—DALLAS *Nature-Studies*, p. 45. (Hum., 1888.)

1318. FOSSILS OF THE COAL PERIOD—*Evidence of Warm and Uniform Climate.*—The flora of the coal appears to indicate a uniform and mild temperature in the air, while the fossils of the contemporaneous mountain limestone, comprising abundance of lamelliferous corals, large-chambered cephalopods, and *Crinoidea*, naturally lead us to infer a considerable warmth in the waters of the northern sea of the Carboniferous period. So also in regard to strata older than the coal, they contain in high northern latitudes mountain masses of corals which must have lived and grown on the spot, and large-chambered univalves, such as *Orthocerata* and *Nautilus*, all seeming to indicate, even in regions bordering on the arctic circle, the former prevalence of a temperature more elevated than that now prevailing.

The warmth and humidity of the air, and the uniformity of climate, both in the different seasons of the year and in different latitudes, appear to have been most remarkable when some of the oldest of the fossiliferous strata were formed.—LYELL *Principles of Geology*, bk. i, ch. 6, p. 91. (A., 1854.)

1319. FOSSILS OF THE OLD RED SANDSTONE—*Fantastic Forms That Have Become Extinct.*—Half my closet walls are covered with the peculiar fossils of the Lower Old Red Sandstone; and certainly a stranger assemblage of forms have rarely been grouped together—creatures whose very type is lost, fantastic and uncouth, and which puzzle the naturalist to assign them even their class—boat-like animals, furnished with oars and a rudder—fish-plated over, like the tortoise, above and below, with a strong armor of bone, and furnished with but one solitary rudder-like fin; other fish less equivocal in their form, but with the membranes of their fins thickly covered with scales—creatures bristling over with thorns; others glistening in an enameled coat, as if beautifully japanned—the tail, in every instance among the less equivocal shapes, formed not equally, as in existing fish, on each side the central vertebral column, but chiefly on the lower side—the column sending out its diminished vertebræ to the extreme termination of the fin. All the forms testify of a remote antiquity—of a period whose "fashions have passed away." The figures on a Chinese vase or an Egyptian obelisk are scarce more unlike what now exists in Nature than the fossils of the Lower Old Red Sandstone.—MILLER *The Old Red Sandstone*, ch. 2, p. 30. (G. & L., 1851.)

1320. FOUNDERS OF PHYSICAL SCIENCE—*Arabs Deserve the Title.*—The Arabs, a people of Semitic origin, partially dispelled the barbarism which had shrouded Europe for upward of two hundred years after the

storms by which it had been shaken, from the aggressions of hostile nations. The Arabs lead us back to the imperishable sources of Greek philosophy; and besides the influence thus exercised on scientific cultivation, they have also extended and opened new paths in the domain of natural investigation. . . . The Arabs are to be regarded as the actual founders of physical science, considered in the sense which we now apply to the words.

It is undoubtedly extremely difficult to associate any absolute beginning with any definite epoch of time in the history of the mental world and of the intimately connected elements of thought. Individual luminous points of knowledge, and the processes by which knowledge was gradually attained, may be traced scattered through very early periods of time. How great is the difference that separates Dioscorides, who distilled mercury from cinnabar, from the Arabian chemist Dscheber; how widely is Ptolemy, as an optician, removed from Alhazen; but we must, nevertheless, date the foundation of the physical sciences, and even of natural science, from the point where new paths were first trodden by many different investigators, altho with unequal success.—Humboldt *Cosmos*, vol. ii, pt. ii, pp. 201-209. (H., 1897.)

1321. FRAGMENT OF ANCIENT EARTH—*Mountain Carved from Vaster Mass.*—How this wondrous mountain [the Matterhorn] has been formed will be the subject of subsequent inquiry. It is not a spurt of molten matter ejected from the nucleus of the earth; from base to summit there is no truly igneous rock. It has no doubt been upraised by subterranean forces, but that it has been lifted as an isolated mass is not conceivable. It must have formed part of a mighty boss or swelling, from which the mountain was subsequently sculptured.—Tyndall *Hours of Exercise in the Alps*, ch. 14, p. 164. (A., 1898.)

1322. FRAGMENT PRESERVED FROM LOST WORK OF ARISTOTLE—*Description of Natural Beauty—An Argument for Creative Power.*—We possess a genuine fragment which Cicero ["De Natura Deorum," ii, 37] has preserved to us from a lost work of Aristotle. It runs thus: "If there were beings who lived in the depths of the earth, in dwellings adorned with statues and paintings and everything which is possessed in rich abundance by those whom we esteem fortunate; and if these beings could receive tidings of the power and might of the gods, and could then emerge from their hidden dwellings through the open fissures of the earth to the places which we inhabit; if they could suddenly behold the earth, and the sea, and the vault of heaven; could recognize the expanse of the cloudy firmament, and the might of the winds of heaven, and admire the sun in its majesty, beauty, and radiant effulgence; and, lastly, when night veiled the earth in darkness, they could behold the starry heavens, the changing moon, and the stars rising and setting in the unvarying course ordained from eternity—they would surely exclaim, 'There are gods, and such great things must be the work of their hands.'" It has been justly observed that this passage is alone sufficient to corroborate Cicero's opinion of "the golden flow of Aristotle's eloquence," and that his words are pervaded by something of the inspired force of Plato's genius. Such a testimony to the existence of the heavenly powers, drawn from the beauty and stupendous greatness of the works of creation, is rarely to be met with in the works of antiquity.—Humboldt *Cosmos*, vol. ii, pt. i, p. 29. (H., 1897.)

1323. FREEDOM AND INDEPENDENCE OF THE SEXES IN AMERICA—*Youthful Acquaintanceships—Coeducation.*—It has been given especially to one nation to lead the world in its assault upon this mistaken law [of separation of sexes in youth], and to demonstrate to mankind that in the unconstrained and artless relations of youth lie higher safeguards than the polite conventions of society can afford. The people of America have proved that the blending of the sweet currents of different family lives in social intercourse, in recreation, and—most original of all—in education, can take place freely and joyously without any sacrifice of man's reverence for woman, or woman's reverence for herself; and, springing out of these naturally mingled lives, there must more and more come those sacred and happy homes which are the surest guaranties for the moral progress of a nation. So long as the first concern of a country is for its homes, it matters little what it seeks second or third.—Drummond *Ascent of Man*, ch. 9, p. 304. (J. P., 1900.)

1324. FREEDOM AND NECESSITY—*Freedom To Do Right.*—I protest that if some great Power would agree to make me always think what is true and do what is right, on condition of being turned into a sort of clock and wound up every morning before I got out of bed, I should instantly close with the offer. The only freedom I care about is the freedom to do right; the freedom to do wrong I am ready to part with on the cheapest terms to any one who will take it of me.—Huxley *Lay Sermons*, serm. 14, p. 340. (G. P. P., 1899.)

1325. FREEDOM NOT ABSOLUTE—*Exemption from Some Special Restraint.*—Is man's voluntary agency a delusion, or is it, on the contrary, just what we feel it to be, and is it only from misconception of its nature that we puzzle over its relation to law? We speak, and speak truly, of our wills being free; but free from what? It seems to be forgotten that freedom is not an absolute, but a relative term. There is no such thing existing as absolute freedom—

that is to say, there is nothing existing in the world, or possible even in thought, which is absolutely alone—entirely free from inseparable relationship to some other thing or things. Freedom, therefore, is only intelligible as meaning the being free from some particular kind of restraint.—ARGYLL *Reign of Law*, ch. 6, p. 179. (Burt.)

1326. FREEDOM OF CHANGE—*Honesty and Truth Better than Consistency.*—He [Cope] has been much blamed on account of the constant changes of his views and because he was inconsistent. Unquestionably he did change his views very often. Doubtless some of those changes were necessitated by too great haste in formulation and too great rashness in publication. The freedom to change which he exercised . . . was an offset to his rashness. He exercised a proper scientific spirit in refusing to be always consistent at the expense of truth.—GILL *Address in Memory of Edward Drinker Cope* in *Proceedings of Amer. Assoc. for Advancement of Science*, vol. xlvi, 1897.

1327. FREEDOM OF SAVAGES AN ILLUSION—*Slavery to Barbarous Customs—Irrational Demands on Devotee.*—The truth is that nowhere is the evidence of development in a wrong direction so strong as in the many customs of savage and barbarous nations which are more or less directly connected with religion. The idea has long been abandoned that the savage lives in a condition of freedom as compared with the complicated obligations imposed by civilization. Savages, on the contrary, are under the tyranny of innumerable customs which render their whole life a slavery from the cradle to the grave. And what is most remarkable is the irrational character of most of these customs, and the difficulty of even imagining how they can have become established. They bear all the marks of an origin far distant in time—of a connection with doctrines which have been forgotten, and of conceptions which have run, as it were, to seed. They bear, in short, all the marks of long attrition, like the remnants of a bed of rock which has been broken up at a distant epoch of geological time, and has left no other record of itself than a few worn and incoherent fragments in some far-off conglomerate. Just as these fragments are now held together by common materials which are universally distributed, such as sand or lime, so the worn and broken fragments of old religions are held together, in the shape of barbarous customs, by those common instincts and aspirations of the human mind which follow it in all its stages, whether of growth or of decay.—ARGYLL *Unity of Nature*, ch. 12, p. 285. (Burt.)

1328. FREEMAN, MORAL, VS. MORAL SLAVE *(John viii, 32-36)*—*Avoiding Evil through Love of Good.*—Spinoza long ago wrote in his "Ethics" that anything that a man can avoid under the notion that it is bad he may also avoid under the notion that something else is good. He who habitually acts *sub specie mali*, under the negative notion, the notion of the bad, is called a slave by Spinoza. To him who acts habitually under the notion of good he gives the name of freeman.—JAMES *Talks to Teachers*, ch. 15, p. 194. (H. H. & Co., 1900.)

1329. FREEZING BY RADIATION—*Formation of Artificial Ice in Bengal.*—Wells was the first to explain the formation, artificially, of ice in Bengal, where the substance is never formed naturally. Shallow pits are dug, which are partially filled with straw, and on the straw flat pans containing water are exposed to the clear firmament. The water is a powerful radiant, and sends off its heat copiously into space. The heat thus lost cannot be supplied from the earth—this source being cut off by the non-conducting straw. Before sunrise a cake of ice is formed in each vessel. This is the explanation of Wells, and it is, no doubt, the true one. I think, however, it needs supplementing. It appears, from the description, that the condition most suitable for the formation of ice is not only a clear air, but a dry air. The nights, says Sir Robert Barker, most favorable for the production of ice, are those which are clearest and most serene, and *in which very little dew appears after midnight.* The italicized phrase is very significant. To produce the ice in abundance, the atmosphere must not only be clear, but it must be comparatively free from aqueous vapor. When the straw on which the pans were laid became wet, it was always changed for dry straw; and the reason Wells assigned for this was, that the straw, by being wetted, was rendered more compact and efficient as a conductor. This may have been the case, but it is also certain that the vapor rising from the wet straw, and overspreading the pans like a screen, would check the chill and retard the congelation.—TYNDALL *Heat a Mode of Motion*, lect. 17, p. 500. (A., 1900.)

1330. FREEZING BY RAREFACTION—Joseph Henry read a communication [March 2, 1825] on the production of cold by the rarefaction of air, accompanied with experiments.

One of these experiments most strikingly illustrated the great reduction of temperature which takes place on the sudden rarefaction of condensed air. Half a pint of water was poured into a strong copper vessel, of a globular form, and having a capacity of five gallons; a tube of one-fourth of an inch in caliber, with a number of holes near the lower end and a stop-cock attached to the other extremity, was firmly screwed into the neck of the vessel; the lower end of the tube dipped into the water, but a number of the holes were above the surface of the liquid, so that a jet of air mingled with water might be thrown from the fountain. The apparatus was then charged with condensed air, by means of a powerful condensing-pump, until the pressure was esti-

mated at nine atmospheres; during the condensation the vessel became sensibly warm. After suffering the apparatus to cool down to the temperature of the room, the stop-cock was opened; the air rushed out with great violence, carrying with it a quantity of water, which was instantly converted into snow; after a few seconds the tube became filled with ice, which almost entirely stopped the current of air. The neck of the vessel was then partially unscrewed, so as to allow the condensed air to rush out around the sides of the screw; in this state the temperature of the whole atmosphere was so much reduced as to freeze the remaining water in the vessel; the stop-cock and tube at the same time became so cold that the fingers adhered to them, in the same manner that they are sometimes found to stick to the latch of a door on an intensely cold morning. This experiment was exhibited to the Institute within six feet of a large stove, and in a room the temperature of which was not less than eighty degrees of Fahrenheit's thermometer.—HENRY *Proceedings of Albany Institute*, vol. i, p. 39.

1331. FREEZING NOT DESTRUCTIVE OF MICRO-ORGANISMS—*Bacteria in Ice.*—Ice contains bacteria in varying quantities from 20 per c. c. to 10,000 or more. Nor is variation in number affected alone by the condition of the water, for samples collected from one and the same place differ widely. The quality follows in large measure the standard of the water.—NEWMAN *Bacteria*, ch. 6, p. 238. (G. P. P., 1899.)

1332. FREEZING, SUDDEN, OF NORTHERN RIVER—*Wild Oxen Frozen in Tibet in Act of Swimming.*—A herd of mammoths returning from their summer pastures in the north may have been surprised, while crossing a stream, by the sudden congelation of the waters. The missionary Huc relates, in his travels in Tibet in 1846, that, after many of his party had been frozen to death, they pitched their tents on the banks of the Mouroui-Ousson (which lower down becomes the famous Blue River), and saw from their encampment "some black shapeless objects ranged in file across the stream. As they advanced nearer no change either in form or distinctness was apparent; nor was it till they were quite close that they recognized in them a troop of the wild oxen, called yak by the Tibetans. There were more than fifty of them incrusted in the ice. No doubt they had tried to swim across at the moment of congelation, and had been unable to disengage themselves. Their beautiful heads, surmounted by huge horns, were still above the surface, but their bodies were held fast in the ice, which was so transparent that the position of the imprudent beasts was easily distinguishable; they looked as if still swimming, but the eagles and ravens had pecked out their eyes."—LYELL *Principles of Geology*, bk. i, ch. 6, p. 85. (A., 1854.)

1333. FRENZY AN OUTCOME OF INFIRMITY—*Indulgence Destroys Self-control—Responsibility at Outset.*—The habit of yielding to a natural infirmity of temper often leads into paroxysms of ungovernable rage, which, in their turn, pass into a state of maniacal excitement. The poor girl who drowns herself after a quarrel with her lover, or the nurse-maid who cuts the throat of a child to whom she is tenderly attached, because her mistress has rebuked her for wearing too fine a bonnet, may be really laboring under a "temporary insanity" which drives her irresistibly to a great crime; yet, just as the man who commits a murder in a state of drunken frenzy is responsible for his irresponsibility, so is the suicide or the murderess, in so far as she has habitually neglected to control the wayward feelings whose strong excitement has impelled her to the commission of her crime.—CARPENTER *Mental Physiology*, ch. 7, p. 323. (A., 1900.)

1334. FUSION OF ROCKS—*Granite and Porphyry Cooled under Pressure—Subterranean Lakes of Melted Lava Now Existing.*—It may indeed be said that we have as yet no data for estimating the relative volume of matter simultaneously in a state of fusion at two given periods, as if we were to compare the columnar basalt of Staffa and its environs with the lava poured out in Iceland in 1783; but for this very reason it would be rash and unphilosophical to assume an excess of ancient as contrasted with modern outpourings of melted matter at particular periods of time. It would be still more presumptuous to take for granted that the more deep-seated effects of subterranean heat surpassed at remote eras the corresponding effects of internal heat in our own times. Certain porphyries and granites, and all the rocks commonly called Plutonic, are now generally supposed to have resulted from the slow cooling of materials fused and solidified under great pressure; and we cannot doubt that beneath existing volcanoes there are large spaces filled with melted stone, which must for centuries remain in an incandescent state, and then cool and become hard and crystalline when the subterranean heat shall be exhausted. That lakes of lava are continuous for hundreds of miles beneath the Chilean Andes seems established by observations made in the year 1835.—LYELL *Principles of Geology*, bk. i, ch. 11, p. 161. (A., 1854.)

1335. FUTURE MUST BE BASED UPON A PAST—*The Masses a Rising Power.*—We fail to see any scientific connection between his [Comte's] theoretical explanation of the past progress of society and his proposals for future improvement. The proposals are not, as we might expect, recommended as that towards which human society has been tending and working through the whole of history. It is thus that thinkers have usually proceeded who formed the-

ories for the future grounded on historical analysis of the past. Tocqueville, for example, and others, finding, as they thought, through all history, a steady progress in the direction of social and political equality, argued that, to smooth this transition, and make the best of what is certainly coming, is the proper employment of political foresight. We do not find M. Comte supporting his recommendations by a similar line of argument. They rest as completely, each on its separate reasons of supposed utility, as with philosophers who, like Bentham, theorize on politics without any historical basis at all. The only bridge of connection which leads from his historical speculations to his practical conclusions is the inference that, since the old powers of society, both in the region of thought and of action, are declining and destined to disappear, leaving only the two rising powers—positive thinkers on the one hand, leaders of industry on the other—the future necessarily belongs to these: spiritual power to the former, temporal to the latter. As a specimen of historical forecast this is very deficient; for are there not the masses as well as the leaders of industry? and is not theirs also a growing power?—MILL *Positive Philosophy of Auguste Comte*, p. 107. (H. H. & Co., 1887.)

1336. FUTURE OF ASTRONOMY—*All Present Knowledge But a Beginning—A Reaching-up toward God.*—Outside the solar system, the problems which demand a practical solution are all but infinite in number and extent. And these have all arisen and crowded upon our thoughts within less than a hundred years. For sidereal science became a recognized branch of astronomy only through Herschel's discovery of the revolutions of double stars in 1802. Yet already it may be and has been called "the astronomy of the future": so rapidly has the development of a keen and universal interest attended and stimulated the growth of power to investigate this sublime subject. What has been done is little—is scarcely a beginning; yet it is much in comparison with the total blank of a century past. And our knowledge will, we are easily persuaded, appear in turn the merest ignorance to those who come after us. Yet it is not to be despised, since by it we reach up groping fingers to touch the hem of the garment of the Most High.—CLERKE *History of Astronomy*, pt. ii, ch. 13, p. 528. (Bl., 1893.)

1337. FUTURE OF EARTH NOT TO BE SUNLESS—*Provision for Vast Duration of the Sun.*—We may therefore assume with great probability that the sun will still continue in its condensation, even if it only attained the density of the earth—tho it will probably become far denser in the interior owing to the enormous pressure—this would develop fresh quantities of heat, which would be sufficient to maintain for an additional 17,000,000 of years the same intensity of sunshine as that which is now the source of all terrestrial life.—HELMHOLTZ *Popular Lectures*, lect. 4, p. 182. (L. G. & Co., 1898.)

1338. FUTURE TO SURPASS PRESENT—Even in our own time we may hope to see some improvement; but the unselfish mind will find its highest gratification in the belief that, whatever may be the case with ourselves, our descendants will understand many things which are hidden from us now, will better appreciate the beautiful world in which we live, avoid much of that suffering to which we are subject, enjoy many blessings of which we are not yet worthy, and escape many of those temptations which we deplore, but cannot wholly resist.—AVEBURY *Prehistoric Times*, ch. 16, p. 577. (A., 1900.)

1339. GAMBLING, FOLLY OF—*Mathematical Calculation of Bank's Sure Winnings.*—Games which exercise either body or mind have been of high value in civilization as trainers of man's faculties. Games of pure chance played for money stand on quite a different footing; they have been from the first a delusion and a curse. In our own time there is perhaps no more pitiable sign of the slowness with which scientific ideas spread than to hear the well-dressed crowds round the gaming-table at Monaco talking about runs of luck, and fancying that it makes a difference whether one backs the black or the red. This goes on, altho schoolboys are now taught the real doctrine of chances, and how to reckon the fixed percentage of each week's stakes that will be raked in by the croupier, and not come back.—TYLOR *Anthropology*, ch. 12, p. 308. (A., 1898.)

1340. GANGES WASHING DOWN A CONTINENT—*Soil Transported by Great River—Human Building Insignificant in Comparison.*—The Rev. Mr. Everest instituted, in 1831-2, a series of observations on the earthy matter brought down by the Ganges, at Ghazepoor, 500 miles from the sea. He found that, in 1831, the number of cubic feet of water discharged by the river per second at that place was, during the

Rains (4 months)	494,208
Winter (5 months)	71,200
Hot weather (3 months)	36,330

so that we may state in round numbers that 500,000 cubic feet per second flow down during the four months of the flood season, from June to September, and less than 60,000 per second during the remaining eight months.

The average quantity of solid matter suspended in the water during the rains was, by weight, $\frac{1}{428}$th part; but as the water is about one-half the specific gravity of the dried mud, the solid matter discharged is $\frac{1}{856}$th part in bulk, or 577 cubic feet per second. This gives a total of 6,082,041,600 cubic feet for the discharge in the 122 days

of the rain. The proportion of sediment in the waters at other seasons was comparatively insignificant, the total amount during the five winter months being only 247,-881,600 cubic feet, and during the three months of hot weather 38,154,240 cubic feet. The total annual discharge, then, would be 6,368,077,440 cubic feet.

This quantity of mud would in one year raise a surface of 228½ square miles, or a square space each side of which should measure 15 miles, a height of one foot. To give some idea of the magnitude of this result, we will assume that the specific gravity of the dried mud is only one-half that of granite (it would, however, be more); in that case, the earthy matter discharged in a year would equal 3,184,038,720 cubic feet of granite. Now about 12½ cubic feet of granite weigh one ton; and it is computed that the Great Pyramid of Egypt, if it were a solid mass of granite, would weigh about 600,000,000 tons. The mass of matter, therefore, carried down annually would, according to this estimate, more than equal in weight and bulk forty-two of the great pyramids of Egypt, and that borne down in the four months of the rains would equal forty pyramids. But if, without any conjecture as to what may have been the specific gravity of the mud, we attend merely to the weight of solid matter actually proved by Mr. Everest to have been contained in the water, we find that the number of tons' weight which passed down in the 122 days of the rainy season was 339,413,760, which would give the weight of fifty-six pyramids and a half; and in the whole year 355,361,-464 tons, or nearly the weight of sixty pyramids. The base of the Great Pyramid of Egypt covers eleven acres, and its perpendicular height is about five hundred feet.—LYELL *Principles of Geology*, bk. ii, ch. 18, p. 282. (A., 1854.)

1341. ——— ——— *Work of Nature and of Man Compared.*—It is scarcely possible to present any picture to the mind which will convey an adequate conception of the mighty scale of this operation, so tranquilly and almost insensibly carried on by the Ganges, as it glides through its alluvial plain, even at a distance of 500 miles from the sea. It may, however, be stated, that if a fleet of more than eighty Indiamen, each freighted with about 1,400 tons' weight of mud, were to sail down the river every hour of every day and night for four months continuously, they would only transport from the higher country to the sea a mass of solid matter equal to that borne down by the Ganges, even in this part of its course, in the four months of the flood season. Or the exertions of a fleet of about 2,000 such ships going down daily with the same burden, and discharging it into the gulf, would be no more than equivalent to the operations of the great river.—LYELL *Principles of Geology*, bk. ii, ch. 18, p. 282. (A., 1854.)

1342. GEMS, ARTIFICIAL, INFERIOR —*Nature's Laboratories Surpass Those of Man.*—But most of the crystals of minerals which have been thus artificially formed are of minute, indeed often of microscopic, dimensions. In the underground reservoirs beneath volcanoes, however, we have all the necessary conditions for the formation of crystals of minerals on a far grander scale. High temperatures, pressures far greater than any we can command at the earth's surface, the action of superheated steam and many acid gases on the various constituents of both igneous and sedimentary rocks, and, above all, time of almost unlimited duration; these constitute such a set of conditions as may fairly be expected to result in the formation of crystals similar to those artificially produced, but of far greater size and beauty.—JUDD *Volcanoes*, ch. 5, p. 148. (A., 1899.)

1343. GENERATION, SPONTANEOUS —*Science Finds No Evidence of.*—If you ask me whether there exists the least evidence to prove that any form of life can be developed out of matter, without demonstrable antecedent life, my reply is that evidence considered perfectly conclusive by many has been adduced; and that were some of us who have pondered this question to follow a very common example, and accept testimony because it falls in with our belief, we also should eagerly close with the evidence referred to. But there is in the true man of science a desire stronger than the wish to have his beliefs upheld; namely, the desire to have them true. And this stronger wish causes him to reject the most plausible support if he has reason to suspect that it is vitiated by error. Those to whom I refer as having studied this question, believing the evidence offered in favor of "spontaneous generation" to be thus vitiated, cannot accept it. They know full well that the chemist now prepares from inorganic matter a vast array of substances which were some time ago regarded as the sole products of vitality. They are intimately acquainted with the structural power of matter, as evidenced in the phenomena of crystallization. They can justify scientifically their belief in its potency, under the proper conditions, to produce organisms. But, in reply to your question, they will frankly admit their inability to point to any satisfactory experimental proof that life can be developed save from demonstrable antecedent life.—TYNDALL *Fragments of Science (the Belfast Address)*, vol. ii, ch. 9, p. 191. (A., 1900.)

1344. ——— ——— *Theory of, Refuted* —*Biogenesis and Abiogenesis—Pasteur and Tyndall.*—Scientific men began to believe that no form of life arose *de novo (abiogenesis)*, but had its source in previous life *(biogenesis)*. It remained to Pasteur and Tyndall to demonstrate this beyond dispute and put to rout the fresh arguments for spontaneous generation which Pouchet had

advanced as late as 1859. Pasteur collected the floating dust of the air, and found by means of the microscope many organized particles, which he sowed on suitable infusions, and thus obtained rich crops of "animalculæ." He also demonstrated that these organisms existed in different degrees in different atmospheres, few in the pure air of the Mer de Glace, more in the air of the plains, most in the air of towns. He further proved that it was not necessary to insist upon hermetic sealing or cotton filters to keep these living organisms in the air from gaining access to a flask of infusion. If the neck of the flask were drawn out into a long tube and turned downwards, and then a little upwards, even tho the end be left open, no contamination gained access. Hence, if the infusion were boiled, no putrefaction would occur. The organisms which fell into the open end of the tube were arrested in the condensation water in the angle of the tube: but even if that were not so, the force of gravity acting upon them prevented them from passing up the long arm of the tube into the neck of the flask. [See PASTEUR.]—NEWMAN *Bacteria*, ch. 1, p. 4. (G. P. P., 1899.)

1345. ——— ——— *Universal Ancient Belief in—Lucretius.*—It did not enter their minds even to doubt that these low forms of life were generated in the matters in which they made their appearance. Lucretius, who had drunk deeper of the scientific spirit than any poet of ancient or modern times except Goethe, intends to speak as a philosopher, rather than as a poet, when he writes that "with good reason the earth has gotten the name of mother, since all things are produced out of the earth. And many living creatures, even now, spring out of the earth, taking form by the rains and the heat of the sun."—HUXLEY *Lay Sermons*, serm. 15, p. 346. (A., 1895.)

1346. GENIUS ACCOMPANIED BY TIRELESS INDUSTRY—*Herschel Making His Own Reflectors—Undaunted by Many Failures—A Sister's Devotion.*—Having purchased the apparatus of a Quaker optician, he [Herschel] set about the manufacture of specula with a zeal which seemed to anticipate the wonders they were to disclose to him. It was not until fifteen years later that his grinding and polishing machines were invented, so the work had at that time to be entirely done by hand. During this tedious and laborious process (which could not be interrupted without injury, and lasted on one occasion sixteen hours), his strength was supported by morsels of food put into his mouth by his sister, and his mind amused by her reading aloud to him the "Arabian Nights," "Don Quixote," or other light works. At length, after repeated failures, he found himself provided with a reflecting telescope—a 5½-foot Gregorian—of his own construction. A copy of his first observation with it on the great nebula in Orion—an object of continual amazement and assiduous inquiry to him—is preserved by the Royal Society. It bears the date March 4, 1774.—CLERKE *History of Astronomy*, ch. 1, p. 14. (Bl., 1893.)

1347. GENIUS DEVELOPED BY LABOR—*Studious Industry of Mozart.*—That, notwithstanding the exuberance of his own creative power, Mozart constantly disciplined it by the most sedulous study, and that he could, without being chargeable with imitation, assimilate (so to speak) into his own musical constitution all that he found suitable in the works of others as pabulum for his genius, is one of its most remarkable features. "It is a very great error," he wrote to a friend, "to suppose that my art has become so exceedingly easy to me. I assure you there is scarcely any one who has worked at the study of composition as I have. You could hardly mention any famous composer whose writings I have not diligently and repeatedly studied throughout." And, in this self-education, as Mr. Holmes remarks, "whatever of striking, new, or beautiful he met with in the works of others, left its impression on him; and he often reproduced these effects, not servilely, but mingling his own nature and feeling with them, in a manner not less surprising than delightful."—CARPENTER *Mental Physiology*, ch. 6, p. 274. (A., 1900.)

1348. GENIUS, INSPIRATION OF—*How Mozart Composed.*—We shall now endeavor to trace out the manner in which he [Mozart] worked; and of this we fortunately have a pretty full account from himself in a letter to a friend:

"You say you should like to know my way of composing, and what method I follow in writing works of some extent. I can really say no more on the subject than the following, for I myself know no more about it, and cannot account for it. When I am, as it were, completely myself, entirely alone, and of good cheer, say, traveling in a carriage, or walking after a good meal, or during the night when I cannot sleep; it is on such occasions that my ideas flow best and most abundantly. Whence and how they come I know not, nor can I force them. Those ideas that please me I retain in my memory, and am accustomed (as I have been told) to hum them to myself. If I continue in this way, it soon occurs to me how I may turn this or that *morceau* to account, so as to make a good dish of it, that is to say, agreeably to the rules of counterpoint, to the peculiarities of the various instruments, etc.

"All this fires my soul, and, provided I am not disturbed, my subject enlarges itself, becomes methodized and defined, and the whole, tho it be long, stands almost complete and finished in my mind, so that I can survey it like a fine picture, or a beautiful statue, at a glance. Nor do I hear in my imagination the parts successively, but I

hear them, as it were, all at once *(gleich alles zusammen)*. What a delight this is I cannot tell! All this inventing, this pondering, takes place in a pleasing lively dream. Still the actual hearing of the *tout ensemble* is after all the best. What has been thus produced I do not easily forget, and this is perhaps the best gift I have my Divine Maker to thank for.

"When I proceed to write down my ideas I take out of the bag of my memory, if I may use that phrase, what has previously been collected into it in the way I have mentioned. For this reason, the committing to paper is done easily enough; for everything is, as I said before, already finished; and it rarely differs on paper from what it was in my imagination."—HOLMES *Life of Mozart*, quoted by CARPENTER in *Mental Physiology*, ch. 6, p. 272. (A., 1900.)

1349. GENIUS OF DISCOVERY—*Aristotle's Absurd Physics and Immortal Logic.*—The genius of discovery depends altogether on the number of these random notions and guesses which visit the investigator's mind. To be fertile in hypotheses is the first requisite, and to be willing to throw them away the moment experience contradicts them is the next . . . The important thing to notice is that the good flashes and the bad flashes, the triumphant hypotheses and the absurd conceits, are on an exact equality in respect of their origin. Aristotle's absurd physics and his immortal logic flow from one source: the forces that produce the one produce the other.—JAMES *Essays in Popular Philosophy*, p. 249. (L. G. & Co., 1899.)

1350. GENIUS OF PRIMITIVE MECHANICS—*Wonderful Results with Meager Resources.*—The first of them [mechanics] had a poorly furnished workshop. "His body," as Emerson says, "was a whole chest of tools." But he had not the knack of using them. He was naked and houseless. His needs, out of which all arts in all ages spring, were few. His mission was to subdue the earth and to redeem it. Compared with his progeny of our day, he would seem an object of pity. But his brain was superabundant. His soul was full of capacities. He was the father of us all.—MASON *Aboriginal American Mechanics* in *Memoirs of Int. Congress of Anthropology*, p. 69. (Sch. P. C.)

1351. GENIUS QUENCHED—*Crushing Power of Hostile Criticism—Great Discoverer Ridiculed.*—It is quite true, as Helmholtz says, that Young was in advance of his age; but something is to be added which illustrates the responsibility of our public writers. For twenty years this man of genius was quenched—hidden from the appreciative intellect of his countrymen—deemed in fact a dreamer, through the vigorous sarcasm of a writer who had then possession of the public ear, and who in the *Edinburgh Review* poured ridicule upon Young and his speculations. To the celebrated Frenchmen Fresnel and Arago he was first indebted for the restitution of his rights; for they, especially Fresnel, remade independently, as Helmholtz says, and vastly extended his discoveries. To the students of his works Young has long since appeared in his true light, but these twenty blank years pushed him from the public mind, which became in turn filled with the fame of Young's colleague at the Royal Institution, Davy, and afterwards with the fame of Faraday. Carlyle refers to a remark of Novalis, that a man's self-trust is enormously increased the moment he finds that others believe in him. If the opposite remark be true—if it be a fact that public disbelief weakens a man's force—there is no calculating the amount of damage these twenty years of neglect may have done to Young's productiveness as an investigator. It remains to be stated that his assailant was Mr. Henry Brougham, afterwards Lord Chancellor of England.—TYNDALL *Lectures on Light*, lect. 2, p. 51. (A., 1898.)

1352. GENIUS SEES ABSTRACT TRUTH—*Phenomena Moved by an Unseen Something behind Them.*—The human mind, in the exercise of its own faculties and powers, sometimes by careful reasoning, sometimes by the intuitions of genius unconscious of any process, is able, from time to time, to reach now one, now another, of those purely intellectual conceptions which are the basis of all that is intelligible to us in the order of the material world. We look for an ideal order or simplicity in material law; and the very possibility of exact science depends upon the fact that such ideal order does actually prevail, and is related to the abstract conceptions of our own intellectual nature. It is in this way that many of the greatest discoveries of science have been made. Especially have the great pioneers in new paths of discovery been led to the opening of those paths by that fine sense for abstract truths which is the noblest gift of genius. Copernicus, Kepler, and Galileo were all guided in their profound interpretations of visible phenomena by those intuitions which arise in minds finely organized, brought into close relations with the mind of nature, and highly trained in the exercise of speculative thought. They guessed the truth before they proved it to be true; and those guesses had their origin in abstract ideas of the mind, which turned out to be ideas really embodied in the order of the universe. So constantly has this recurred in the history of science that, as Dr. Whewell ["History of the Inductive Sciences," 2d edition, vol. i, p. 434] says, it is not to be considered as an exception, but as the rule.—ARGYLL *Reign of Law*, ch. 2, p. 66. (Burt.)

1353. GENIUS UNFAVORABLE TO VOLUNTARY ATTENTION—*Holding Attention upon One Subject Gives Mastery.*—It is probable that genius tends actually to pre-

vent a man from acquiring habits of voluntary attention, and that moderate intellectual endowments are the soil in which we may best expect, here as elsewhere, the virtues of the will, strictly so called, to thrive. But, whether the attention come by grace of genius or by dint of will, the longer one does attend to a topic the more mastery of it one has. And the faculty of voluntarily bringing back a wandering attention, over and over again, is the very root of judgment, character, and will. No one is *compos sui* if he have it not.—JAMES *Psychology*, vol. i, ch. 11, p. 424. (H. H. & Co., 1899.)

1354. GEOGRAPHY AND ETHNOLOGY, MEDIEVAL—*Travelers of Middle Ages—Their Works Dramatic—The Public Ignorant and Credulous.*—The earlier travelers of the Middle Ages, as for instance John Mandèville (1353), Hans Schiltberger of Munich (1425), and Bernhard von Breytenback (1486), delight us even in the present day by their charming simplicity, their freedom of style, and the self-confidence with which they step before a public, who, from their utter ignorance, listen with the greater curiosity and readiness of belief, because they have not as yet learned to feel ashamed of appearing ignorant, amused, or astonished. The interest attached to the narratives of travels was then almost wholly dramatic, and the necessary and easily introduced admixture of the marvelous gave them almost an epic coloring. The manners of foreign nations are not so much described as they are rendered incidentally discernible by the contact of the travelers with the natives. The vegetation is unnamed and unheeded, with the exception of an occasional allusion to some pleasantly flavored or strangely formed fruit, or to the extraordinary dimensions of particular kinds of stems or leaves of plants. Among animals, they describe, with the greatest predilection, first, those which exhibit most resemblance to the human form, and next, those which are the wildest and most formidable. The contemporaries of these travelers believed in all the dangers which few of them had shared, and the slowness of navigation and the want of means of communication caused the Indies, as all the tropical regions were then called, to appear at an immeasurable distance. Columbus was not yet justified in writing to Queen Isabella, "the world is small, much smaller than people suppose."—HUMBOLDT *Cosmos*, vol. ii, pt. i, p. 78. (H., 1897.)

1355. GEOLOGY AND HISTORY, ANALOGY OF—*The Present in the Past.*—By these researches into the state of the earth and its inhabitants at former periods, we acquire a more perfect knowledge of its present condition, and more comprehensive views concerning the laws now governing its animate and inanimate productions. When we study history, we obtain a more profound insight into human nature, by instituting a comparison between the present and former states of society. We trace the long series of events which have gradually led to the actual posture of affairs; and by connecting effects with their causes, we are enabled to classify and retain in the memory a multitude of complicated relations—the various peculiarities of national character—the different degrees of moral and intellectual refinement, and numerous other circumstances, which, without historical associations, would be uninteresting or imperfectly understood. As the present condition of nations is the result of many antecedent changes, some extremely remote and others recent, some gradual, others sudden and violent; so the state of the natural world is the result of a long succession of events; and if we would enlarge our experience of the present economy of Nature, we must investigate the effects of her operations in former epochs.—LYELL *Principles of Geology*, bk. i, ch. 1, p. 1. (A., 1854.)

1356. ——— ——— *Relative Utility Yet To Be Proved.*—The discovery of other systems in the boundless regions of space was the triumph of astronomy; to trace the same system through various transformations—to behold it at successive eras adorned with different hills and valleys, lakes and seas, and peopled with new inhabitants, was the delightful meed of geological research. By the geometer were measured the regions of space and the relative distances of the heavenly bodies; by the geologist myriads of ages were reckoned, not by arithmetical computation, but by a train of physical events—a succession of phenomena in the animate and inanimate worlds—signs which convey to our minds more definite ideas than figures can do of the immensity of time.

Whether our investigation of the earth's history and structure will eventually be productive of as great practical benefits to mankind as a knowledge of the distant heavens, must remain for the decision of posterity. It was not till astronomy had been enriched by the observations of many centuries, and had made its way against popular prejudices to the establishment of a sound theory, that its application to the useful arts was most conspicuous. The cultivation of geology began at a later period; and in every step which it has hitherto made towards sound theoretical principles it had to contend against more violent prepossessions. The practical advantages already derived from it have not been inconsiderable; but our generalizations are yet imperfect, and they who come after us may be expected to reap the most valuable fruits of our labor. Meanwhile, the charm of first discovery is our own; and, as we explore this magnificent field of inquiry, the sentiment of a great historian of our times may continually be present to our minds, that "he who calls what has vanished back again into

being enjoys a bliss like that of creating" (Niebuhr, "History of Rome," vol. i, p. 5). —LYELL *Principles of Geology*, bk. i, ch. 4, p. 61. (A., 1854.)

1357. GEOLOGY HAS INDUSTRIAL VALUE—*Money Wasted in Vain Search for Coal—Knowledge of Formations Would Save Outlay.*—"Whatever withdraws us from the power of the senses," says the moralist [Johnson], "whatever makes the past, the distant, or the future predominate over the present, advances us in the dignity of thinking beings." And geology, in a peculiar manner, supplies to the intellect an exercise of this ennobling character. But it has, also, its cash value. The time and money squandered in Great Britain alone in searching for coal in districts where the well-informed geologist could have at once pronounced the search hopeless, would much more than cover the expense at which geological research has been prosecuted throughout the world.—MILLER *Old Red Sandstone*, ch. 10, p. 177. (G. & L., 1851.)

1358. GEOLOGY, ONCE A SYSTEM OF CATASTROPHES—*Now Accords with the Harmony of Nature—Theology Seeks the Same Harmony.*—A century ago there was none [geology]. Science went out to look for it, and brought back a geology which, if Nature were a harmony, had falsehood written almost on its face. It was the Geology of Catastrophism—a geology so out of line with Nature, as revealed by the other sciences, that on a priori grounds a thoughtful mind might have been justified in dismissing it as a final form of any science. And its fallacy was soon and thoroughly exposed. The advent of modified uniformitarian principles all but banished the word "catastrophe" from science, and marked the birth of geology as we know it now. Geology, that is to say, had fallen at last into the great scheme of law. Religious doctrines, many of them at least, have been up to this time all but as catastrophic as the old geology. They are not on the lines of Nature as we have learned to decipher her. If any one feels, as science complains that it feels, that the lie of things in the spiritual world as arranged by theology is not in harmony with the world around, is not, in short, scientific, he is entitled to raise the question whether this be really the final form of those departments of theology to which his complaint refers. He is justified, moreover, in demanding a new investigation with all modern methods and resources; and science is bound by its principles, not less than by the lessons of its own past, to suspend judgment till the last attempt is made. —DRUMMOND *Natural Law in the Spiritual World*, int., p. 17. (H. Al.)

1359. GEOLOGY, ORIGIN OF—*Ancient Egyptians—Herodotus Knew that Egypt Had Been Once Submerged.*—We know that the Egyptian priests were aware, not only that the soil beneath the plains of the Nile, but that also the hills bounding the great valley, contained marine shells; and Herodotus inferred from these facts that all lower Egypt, and even the highlands above Memphis, had once been covered by the sea ["Euterpe," 12]. As similar fossil remains occur in all parts of Asia hitherto explored, far in the interior of the continent as well as near the sea, they could hardly have escaped detection by some Eastern sages not less capable than the Greek historian of reasoning philosophically on natural phenomena.—LYELL *Principles of Geology*, bk. i, ch. 2, p. 6. (A., 1854.)

1360. GEOLOGY TESTIFIES TO A BEGINNING—The chain of life in geological time presents a wonderful testimony to the reality of a beginning. Just as we know that any individual animal must have had its birth, its infancy, its maturity, and will reach an end of life, so we trace species and groups of species to their beginning, watch their culmination, and perhaps follow them to their extinction. . . . But its revelation of the fact that nearly all the animals and plants of the present day had a very recent beginning in geological time, and its disclosure of the disappearance of one form of life after another as we go back in time, till we reach the comparatively few forms of life of the Lower Cambrian, and finally have to rest over the solitary grandeur of *Eozoon*, oblige it to say that nothing known to it is self-existent and eternal.—DAWSON *Facts and Fancies in Modern Science*, lect. 3, p. 118. (A. B. P. S.)

1361. GEOMETRY A GROWTH FROM BUILDER'S ARTS—*The Straight Line Is the Stretched Line.*—It must be clearly understood that elementary geometry was not actually invented by means of definitions, axioms, and demonstrations like Euclid's. Its beginnings really arose out of the daily practical work of land-measurers, masons, carpenters, tailors. This may be seen in the geometrical rules of the altar-builders of ancient India, which do not tell the bricklayer to draw a plan of such and such lines, but to set up poles at certain distances, and stretch cords between them. It is instructive to see that our term *straight line* still shows traces of such an early practical meaning: *line* is *linen* thread, and *straight* is the participle of the old verb *to stretch*. If we stretch a thread tight between two pegs, we see that the stretched thread must be the shortest possible; which suggests how the straight line came to be defined as the shortest distance between two points. Also, every carpenter knows the nature of a right angle, and he is accustomed to parallel lines, or such as keep the same distance from one another.—TYLOR *Anthropology*, ch. 13, p. 319. (A., 1899.)

1362. GERM A SEED—*Each Propagates Only Its Kind.*—From their respective viruses you may plant typhoid fever, scarlatina, or smallpox. What is the crop

that arises from this husbandry? As surely as a thistle rises from a thistle seed, as surely as the fig comes from the fig, the grape from the grape, the thorn from the thorn, so surely does the typhoid virus increase and multiply into typhoid fever, the scarlatina virus into scarlatina, the smallpox virus into smallpox. What is the conclusion that suggests itself here? It is this: That the thing which we vaguely call a virus is to all intents and purposes a seed. Excluding the notion of vitality, in the whole range of chemical science you cannot point to an action which illustrates this perfect parallelism with the phenomena of life—this demonstrated power of self-multiplication and reproduction. The germ theory alone accounts for the phenomena.—TYNDALL *Floating Matter of the Air,* essay 1, p. 41. (A., 1895.)

1363. GERM-DESTROYERS—*White Corpuscles or Leucocytes—The Wise Providence of the Creator—High Purpose Found for Supposedly Useless Organ.*—Quite recently it has been proved that the white corpuscles of the blood, whose function was previously unknown, are really independent living organisms. They are produced in large numbers by the spleen, an organ which has long been a puzzle to physiologists, but whose function and importance to the organism seem to be now made clear. They are much smaller and less numerous than the red blood-globules; they move about quite independently; and they behave in a manner which shows that they are closely allied to, if not identical with, the amebæ found abundantly in stagnant water, and which form such interesting microscopic objects. These minute animal organisms, which inhabit not only our blood-vessels, but all the tissues of the body, have an important function to perform on which our very lives depend. This function is, to devour and destroy the bacteria or germs of disease which may gain an entrance to our blood or tissues, and which, when their increase is unchecked, produce various disorders and even death. Under the higher powers of the microscope the leucocytes, as they are termed, can be observed continually moving about, and on coming in contact with any of these bacteria or their germs, or other hurtful substances, they send out pseudopodia from their protoplasm which envelops the germ and soon causes it to disappear: but they also appear sometimes to produce a secretion which is injurious to the bacteria, and so destroys them, and these may perhaps be distinct organisms.—WALLACE *The Wonderful Century,* ch. 14, p. 145. (D. M. & Co., 1899.)

1364. GERM-THEORY — *Micro-organisms in the Air—Treatment of Wounds.*—Schwann was one of the first to point out that when a decoction of meat is effectually screened from the air, or supplied solely with calcined air, putrefaction does not set in. Helmholtz and Pasteur confirmed this, but it may be said with some truth that Schwann originated the germ-theory, and Lister applied it in the treatment of wounds. Lister believed that if he could surround wounds with filtered air the results would be as good as if they were shut off from the air altogether.—NEWMAN *Bacteria,* ch. 3, p. 101. (G. P. P., 1899.)

1365. GERM, WONDERFUL DEVELOPMENT OF—*The Unseen Artist.*—"Strange possibilities," he [Huxley] says, "lie dormant in that semifluid globule. Let a moderate supply of warmth reach its watery cradle and the plastic matter undergoes changes so rapid and yet so steady and purpose-like in their succession that one can only compare them to those operated by a skilled modeler upon a formless lump of clay. As with an invisible trowel the mass is divided and subdivided into smaller and smaller portions, until it is reduced to an aggregation of granules not too large to build withal the finest fabrics of the nascent organism. And then it is as if a delicate finger traced out the line to be occupied by the spinal column, and molded the contour of the body; pinching up the head at one end, the tail at the other, and fashioning flank and limb into due proportions in so artistic a way that, after watching the process hour by hour, one is almost involuntarily possessed by the notion that some more subtle aid to vision than an achromatic would show the hidden artist, with his plan before him, striving with skilful manipulation to perfect his work."—DRUMMOND *Natural Law in the Spiritual World,* essay 8, p. 260. (H. Al.)

1366. GERMS DESTROYED BY DISCONTINUOUS BOILING—*Softening Period Seized for Each Kind—Theory Proved by Experiment—The Test of Prevision.*—An infusion infected with the most powerfully resistant germs, but otherwise protected against the floating matters of the air, is gradually raised to its boiling-point. Such germs as have reached the soft and plastic state immediately preceding their development into bacteria are thus destroyed. The infusion is then put aside in a warm room for ten or twelve hours. If for twenty-four, we might have the liquid charged with well-developed bacteria. To anticipate this, at the end of ten or twelve hours we raise the infusion a second time to the boiling-temperature, which, as before, destroys all germs then approaching their point of final development. The infusion is again put aside for ten or twelve hours, and the process of heating is repeated. We thus kill the germs *in the order of their resistance,* and finally kill the last of them. No infusion can withstand this process if it be repeated a sufficient number of times. Artichoke, cucumber, and turnip infusions, which had proved specially obstinate when infected with the germs of desiccated hay were com-

pletely broken down by this method of discontinuous heating, three minutes being found sufficient to accomplish what three hundred minutes' continuous boiling failed to accomplish. I applied the method, moreover, to infusions of various kinds of hay, including those most tenacious of life. Not one of them bore the ordeal. These results were clearly foreseen before they were realized, so that the germ-theory fulfils the test of every true theory, that test being the power of prevision.—TYNDALL *Fragments of Science*, vol. ii, ch. 13, p. 321. (A., 1900.)

1367. GERMS EVADE EXPERIMENTERS—*Unharmed by Supposed Fatal Processes—Possibility of Exclusion.*—Germs will pass unwetted and unscathed through sulfuric acid unless the most special care is taken to detain them. . . . The air passes in bubbles through the bulbs; and to make the method [of purifying air by passing it through sulfuric acid] secure, the passage of the air must be so slow as to cause the whole of its floating matter, even to the very core of each bubble, to touch the surrounding liquid. But if this precaution be observed, water will be found quite as effectual as sulfuric acid. By the aid of an air-pump, in a highly infective atmosphere I have thus drawn air for weeks without intermission, first through bulbs containing water, and afterwards through vessels containing organic infusions, without any appearance of life. The germs were not killed by the water, but they were effectually intercepted, while the objection that the air had been injured by being brought into contact with strongly corrosive substances was annulled.—TYNDALL *Floating Matter of the Air*, essay 5, p. 281. (A., 1895.)

1368. GERMS INDISTINGUISHABLE—*Structural Differences Notwithstanding—Oak — Palm — Lichen.* — If a botanist be asked the difference between an oak, a palm-tree, and a lichen, he will declare that they are separated from one another by the broadest line known to classification. Without taking into account the outward differences of size and form, the variety of flower and fruit, the peculiarities of leaf and branch, he sees even in their general architecture types of structure as distinct as Norman, Gothic, and Egyptian. But if the first young germs of these three plants are placed before him and he is called upon to define the difference, he finds it impossible. He cannot even say which is which. Examined under the highest powers of the microscope, they yield no clue. Analyzed by the chemist with all the appliances of his laboratory, they keep their secret.—DRUMMOND *Natural Law in the Spiritual World*, essay 8, p. 257. (H. Al.)

1369. ——— ——— *Uniformity, Apparent, of All in Earliest Stage—Gradual Differentiation through Class, Order, Family, Genus, Species—Individual Repeating History of Race.*—All animals start together as a single cell, so that man cannot be distinguished from the lobster or mollusk. An embryo arises from this cell, which shows itself to be a vertebrate in distinction from an invertebrate, but is as yet not a mammal, but more like a fish. With further development it shows a slight approximation toward the reptiles, but, instead of becoming a member of this class, takes a different course, and declares itself to be a mammal. Next, it turns toward the direction of the primates rather than rodents or ungulates; then it exhibits the characteristics of an ape, in distinction from the lemurs; and finally, just before birth, it takes on the features of man. And this story is repeated in all cases, the line of development being the sub-kingdom, the class, the subclass, the order, the family, the genus, the species—thus coinciding with one treelike classification of animals.—CONN *Evolution of To-day*, ch. 4, p. 148. (G. P. P., 1886.)

1370. ——— ——— *Vegetable and Animal—Worm and Man.*—Compare next the two sets of germs, the vegetable and the animal. And there is still no shade of difference. Oak and palm, worm and man, all start life together. No matter into what strangely different forms they may afterwards develop, no matter whether they are to live on sea or land, creep or fly, swim or walk, think or vegetate, in the embryo as it first meets the eye of science they are indistinguishable. The apple which fell in Newton's garden, Newton's dog Diamond, and Newton himself began life at the same point.—DRUMMOND *Natural Law in the Spiritual World*, essay 8, p. 258. (H. Al.)

1371. GERMS INNUMERABLE—*The Air Thick with Microscopic Life.*—It has been a common objection of abiogenists that, if the doctrine of biogeny is true, the air must be thick with germs; and they regard this as the height of absurdity. But Nature occasionally is exceedingly unreasonable, and Professor Tyndall has proved that this particular absurdity may nevertheless be a reality. He has demonstrated that ordinary air is no better than a sort of stirabout of excessively minute solid particles; that these particles are almost wholly destructible by heat, and that they are strained off, and the air rendered optically pure, by being passed through cotton-wool.—HUXLEY *Lay Sermons*, serm. 15, p. 360. (A., 1895.)

1372. GERMS, SIZE OF, BAFFLES DESCRIPTION—*Infinitesimal Minuteness with Power To Accomplish Vast Results.*—Questions of size are always difficult to settle or determine from a popular point of view, and, when we seek to gain some adequate idea of the dimensions of germs, we are met with the difficulty of translating into terms of common life those of the infinitely little. If we speak of a germ which in length is the one-ten-thousandth part of an inch—that is, equals one part of an inch which has been

divided, as to its length, into ten thousand parts—we utterly fail to grasp any notion of the size indicated. An appeal to figurative description, while more graphic in character perchance, yet leaves us with the dimmest conceptions of the dimensions of germs.

One writer tells us that on the area of a single square inch we could place, in a single layer, a population of common germs or bacteria one hundred times as great as the population of London. Graphic as is this estimate, the idea of the actual size of the individual germs remains simply unattainable. It is this diminutive size compared with the great results in the way of disease certain of these germs may and do produce, which is more than sufficient to appal us.—WILSON *Glimpses of Nature*, ch. 26, p. 84. (Hum., 1892.)

1373. GIANTS AMONG THE SUNS—*Alpha Centauri—Sirius Equals Two Thousand Suns Like Ours in Size.*—We have seen, however, that Alpha Centauri gives out about three times as much light as our sun. It follows that Sirius shines in reality three hundred times more brightly than the sun. Now, this implies that if the surface of Sirius is of the same intrinsic brightness as the sun's—that is, if on the average each square mile of the surface of Sirius gives out the same quantity of light as each square mile of the sun's surface—then the surface of Sirius must be 300 times as large as the sun's. It would follow that the diameter of Sirius is between 17 and 18 times as large as the sun's. (For 17 times 17 are less than 300, and 18 times 18 are greater than 300.) Hence the volume of Sirius would be about 2,200 times as great as the sun's (this number 2,200 being obtained by multiplying 300 by 17⅓, which is nearly equivalent to multiplying 17⅓, twice into itself). This is on the supposition of equal surface-luster; and it cannot be regarded as certain that Sirius is not considerably brighter than our sun as respects his actual surface. Of course if this is the case we cannot assume that Sirius is larger in so great a proportion as when we suppose his intrinsic luster the same as the sun's.

But it is worthy of notice that the eminent French physicist Ste.-Claire-Deville considers it impossible that under any circumstances a surface can be much hotter or more luminous than the solar surface. We shall probably be within the limits of fact if we regard the surface of Sirius as not more than twice as bright as the sun's. This would leave his surface 150 times larger than the sun's, or, for convenience of reckoning, say 144 times; his diameter would thus be twelve times the sun's, and his volume 1,728 times the sun's.

Have I not rightly called Sirius a "king of suns"? From that glorious orb, nearly 2,000 such orbs as the sun, that great and mighty globe, instinct with fire and life, might be formed, each fit to be the center of a scheme of circling worlds as important as that over which our sun bears sway!—PROCTOR *Expanse of Heaven*, pp. 243-245. (L. G. & Co., 1897.)

1374. GIANTS OF PRIMEVAL DAYS—*The Old Man of Cromagnon.*—The reader, reflecting on what he has learned from history may be disposed here to ask: "Must we suppose Adam to have been one of these Turanian men, like 'the old man of Cromagnon'"? In answer, I would say that there is no good reason to regard the first man as having resembled a Greek Apollo or an Adonis. He was probably of sterner and more muscular mold. But the gigantic paleolithic men of the European caves are more probably representatives of that fearful and powerful race who filled the antediluvian world with violence, and who reappear in postdiluvian times as the Anakim and traditional giants, who constitute a feature in the early history of so many countries. Perhaps nothing is more curious in the revelations as to the most ancient cavemen than that they confirm the old belief that there were "giants in those days."—DAWSON *Facts and Fancies in Modern Science*, lect. 4, p. 169. (A. B. P. S.)

1375. GIANTS OF THE VEGETABLE KINGDOM—*Plants and Flowers of the Tropics.*—In the tropics, plants are more succulent, of a fresher green, and have larger and more glossy leaves, than in the northern regions. Social plants, which give such a character of uniformity to European vegetation, are almost wholly absent in the equatorial zone. Trees, almost twice as high as our oaks, there bloom with flowers as large and splendid as our lilies. On the shady banks of the Magdalena River, in South America, grows a climbing *Aristolochia*, whose blossoms, measuring four feet in circumference, the Indian children sportively draw on their heads as caps. In the South Indian Archipelago, the flower of the *Rafflesia* is nearly three feet in diameter, and weighs above fourteen pounds.—HUMBOLDT *Views of Nature*, p. 230. (Bell, 1896.)

1376. GIBRALTAR, STRAITS OF—*Current Flowing from Atlantic into Mediterranean—Supply without Return—A Problem in Nature.*—It is well known that a powerful current sets constantly from the Atlantic into the Mediterranean, and its influence extends along the whole southern borders of that sea, and even to the shores of Asia Minor. Captain Smyth found, during his survey, that the central current ran constantly at the rate of from three to six miles an hour eastward into the Mediterranean, the body of water being three miles and a half wide. But there are also two lateral currents—one on the European and one on the African side, each of them about two miles and a half broad, and flowing at about the same rate as the central stream. These lateral currents ebb and flow with the tide, setting alternately into the Mediterranean and into the Atlantic. The excess

of water constantly flowing in is very great, and there is only one cause to which this can be attributed, the loss of water in the Mediterranean by evaporation. That the level of this sea should be considerably depressed by this cause is quite conceivable, since we know that the winds blowing from the shores of Africa are hot and dry; and hygrometric experiments recently made in Malta and other places show that the mean quantity of moisture in the air investing the Mediterranean is equal only to one-half of that in the atmosphere of England. The temperature also of the great inland sea is upon an average higher, by 3½° of Fahrenheit, than the eastern part of the Atlantic Ocean in the same latitude, which must greatly promote its evaporation. The Black Sea being situated in a higher latitude, and being the receptable of rivers flowing from the north, is much colder, and its expenditure far less; accordingly it does not draw any supply from the Mediterranean, but, on the contrary, contributes to it by a current flowing outwards, for the most part of the year, through the Dardanelles. The discharge, however, at the Bosporus is so small, when compared to the volume of water carried in by rivers, as to imply a great amount of evaporation in the Black Sea.—LYELL *Principles of Geology,* bk. ii, ch. 20, p. 333. (A., 1854.)

1377. GLACIER CHANGING SHAPE— *Fracture and Regelation.*—All the phenomena of motion, on which the idea of viscosity [a view still held by eminent observers, as at least a partial explanation of glacial phenomena—see Russell, "Glaciers of North America"] has been based, are brought by such experiments as the above [of breaking and freezing together the fragments of ice] into harmony with the demonstrable properties of ice. In virtue of this property, the glacier accommodates itself to its bed while preserving its general continuity, crevasses are closed up, and the broken ice of a cascade, such as that of the Talèfre or the Rhone, is recompacted to a solid continuous mass.—TYNDALL *Hours of Exercise in the Alps (Notes on Ice and Glaciers),* ch. 1, p. 355. (A., 1898.)

1378. GLACIER, DISTINCTIVE CARVING OF—*Markings Could Not Be the Work of Floating Ice.*—In the State of Maine I have followed, compass in hand, the same set of furrows, running from north to south in one unvarying line, over a surface of one hundred and thirty miles, from the Katahdin Iron Range to the seashore. These furrows follow all the inequalities of the country, ascending ranges of hills varying from twelve to fifteen hundred feet in height, and descending into the intervening valleys only two or three hundred feet above the sea, or sometimes even on a level with it. I take it to be impossible that a floating mass of ice should travel onward in one rectilinear direction, turning neither to the right nor to the left, for such a distance. Equally impossible would it be for a detached mass of ice, swimming on the surface of the water, or even with its base sunk considerably below it, to furrow in a straight line the summits and sides of the hills, and the bottoms of the intervening valleys. It would be carried over the inequalities of the country without touching the lowest depressions.—AGASSIZ *Journey in Brazil,* ch. 13, p. 402. (H. M. & Co., 1896.)

1379. GLACIER OF CONTINENTAL MAGNITUDE—*Greenland a Type of Ancient North America.*—The vast ice-sheet covering nearly all of Greenland is of the continental type, and, as is well known, is the largest existing ice-body in the northern hemisphere. Its extension northward has not been fully determined, but as nearly as can be judged it terminates in about latitude 82°. Its area is in the neighborhood of 600,000 square miles. If transferred bodily to the eastern portion of the United States, it would extend from northern Maine to Georgia, and cover a belt of country 500 miles broad. Vast as this ice-sheet is known to be, it takes what may be said to be second or third rank when contrasted with the continental glaciers that occupied Canada and a large portion of the United States in Pleistocene times. The exploration of existing glaciers derives one of its principal attractions from the fact that such studies assist in interpreting the records left by ancient glaciers in various parts of the world. This in turn brings one to the consideration of the still broader problems of the cause of climatic changes which favored the growth of vast Pleistocene glaciers in regions now enjoying a temperate climate, and inhabited by the most civilized people of the earth.—RUSSELL *Glaciers of North America,* ch. 2, p. 35. (G. & Co., 1897.)

1380. GLACIERS, FORMING AND MOVEMENT OF — *Rivers Flowing Under Arches of Ice.*—In the temperate zone the snow lies for months in winter on the summit of every high mountain, while in the arctic regions a long summer's day of half a year's duration is insufficient to melt the snow, even on land just raised above the level of the sea. It is therefore not surprising, since the atmosphere becomes colder in proportion as we ascend in it, that there should be heights, even in tropical countries, where the snow never melts. The lowest limit to which the perpetual snow extends downwards from the tops of mountains at the equator is an elevation of not less than 16,000 feet above the sea; while in the Swiss Alps, in lat. 46° N., it reaches as low as 8,500 feet above the same level, the loftier peaks of the Alpine chain being from 12,000 to 15,000 feet high. The frozen mass augmenting from year to year would add indefinitely to the altitude of Alpine summits were it not relieved by its descent through

the larger and deeper valleys to regions far below the general snow-line. To these it slowly finds its way in the form of rivers of ice, called glaciers, the consolidation of which is produced by pressure and by the congelation of water infiltered into the porous mass, which is always undergoing partial liquefaction, and receiving in summer occasional showers of rain on its surface. In a day of hot sunshine or mild rain, innumerable rills of pure and sparkling water run in icy channels along the surface of the glaciers, which in the night shrink and come to nothing. They are often precipitated in bold cascades into deep fissures in the ice, and contribute together with springs to form torrents, which flow in tunnels at the bottom of the glaciers for many a league, and at length issue at their extremities from beneath beautiful caverns or arches. The waters of these streams are always densely charged with the finest mud, produced by the grinding of rock and sand under the weight of the moving mass.—LYELL *Principles of Geology*, bk. ii, ch. 15, p. 222. (A., 1854.)

1381. GLACIERS NOW IN ACTION—*Present Agree with Ancient Results—Continuity of Nature.*—Certainly, no one familiar with the facts could suppose that floating ice or icebergs had abraded, polished, and furrowed the bottom of narrow valleys as we find them worn, polished, and grooved by glaciers. And it must be remembered that this is a theory founded not upon hypothesis, but upon the closest comparison. I have not become acquainted with these marks in regions where glaciers no longer exist, and made a theory to explain their presence. I have, on the contrary, studied them where they are in process of formation. I have seen the glacier engrave its lines, plow its grooves and furrows in the solid rock, and polish the surfaces over which it moved, and was familiar with all this when I found afterwards appearances corresponding exactly to those which I had investigated in the home of the present glaciers. I could therefore say, and I think with some reason, that "this also is the work of the glacier acting in ancient times as it now acts in Switzerland."—AGASSIZ *Geological Sketches*, ser. ii, p. 39. (H. M. & Co., 1896.)

1382. GLASS-MAKING IN NATURE'S LABORATORIES—But when the lava contains no ready-formed crystals, but consists entirely of a glassy substance in a more or less perfect state of fusion, the liberation of steam gives rise to the formation of the beautiful material known as "pumice." Pumice consists of a mass of minute glass bubbles; these bubbles have not usually, however, retained their globular form, but have been elongated in one direction through the movement of the mass while it was still in a plastic state.—JUDD *Volcanoes*, ch. 4, p. 68. (A., 1899.)

1383. GLORY, REFLECTED—*The Light of Planets Not Their Own.*—Our ancestors were far from imagining that these luminous points wandering among the stars do not possess any real light of their own; that they are dark like the earth, and as large as she is; that several are even much larger and heavier than our world; that they are illuminated by the sun, like the earth and moon, neither more nor less; that their distance is small compared to that which separates us from the stars; that they form, with the earth, a family of which the sun is the father! Yes, that luminous point, for example, which shines like a star is Jupiter. It has itself no light, any more than the earth has, but it is illuminated by the sun; and as the earth shines from afar on account of this illumination, so it shines a luminous point in which is condensed all the light scattered over its immense disk. Place a stone on a black cloth in a chamber completely closed to the daylight, throw upon it the rays of the sun by means of an opening suitably arranged, and this stone will shine like the moon and like Jupiter. The planets are dark worlds like ours, and only shine by the solar light which they receive and reflect into space.—FLAMMARION *Popular Astronomy*, bk. iv, ch. 1, p. 330. (A.)

1384. GLORY VEILED FOR HUMAN WEAKNESS—*Blinding Effect of Sun's Light Overcome—Polarizing Eyepiece.*—The projecting apparatus is next removed and replaced by the polarizing eyepiece. Sir William Herschel used to avoid the blinding effects of the concentrated solar light by passing the rays through ink and water, but the phenomena of "polarization" have been used to better advantage in modern apparatus. [In this instrument] the light is polarized with three successive reflections through three tubes. By its aid the eye can be safely placed where the concentrated heat would otherwise melt iron. In practise I have often gazed through it at the sun's face without intermission from four to five hours, with no more fatigue or harm to the eye than in reading a book. By its aid the observer fills in the outline already projected on the paper.—LANGLEY *New Astronomy*, ch. 1, p. 18. (H. M. & Co., 1896.)

1385. GOD CAN REVEAL HIMSELF TO MAN—*Intuitive Perception of the Divine.*—The existence of a Being from whom our own being has been derived involves, at least, the possibility of some communication direct or indirect. Yet the impossibility or the improbability of any such communication is another of the assumptions continually involved in current theories about the origin of religion. Yet it is quite certain that no such assumption can be reasonably made. The perceptions of the human mind are accessible to the intimations of external truth through many avenues of approach. In its very structure it is made to be responsive to some of these intimations

by immediate apprehension. Man has that within him by which the invisible can be seen, and the inaudible can be heard, and the intangible can be felt. Not as the result of any reasoning, but by the same power by which it sees and feels the postulates on which all reasoning rests, the human mind may from the very first have felt that it was in contact with a Mind which was the fountain of its own.—ARGYLL *Unity of Nature*, ch. 11. p. 266. (Burt.)

1386. GOD, LATIN IDEA OF—*Separateness of the Deity vs. Greek Idea of Immanence.*—The general effect of this intellectual movement has been to discredit more than ever before the Latin idea of God as a power outside of the course of Nature and occasionally interfering with it. In all directions the process of evolution has been discovered, working after similar methods, and this has forced upon us the belief in the unity of Nature. We are thus driven to the Greek conception of God as the power working in and through Nature, without interference or infraction of law.—FISKE *Through Nature to God*, pt. iii, ch. 2, p. 147. (H. M. & Co., 1900.)

1387. GOD, SCIENTIFIC CONCEPTION OF—*Theologians Have Often Narrowed the Thought—Science Makes It Sublime.*—The author of "Ecce Homo" may be partially right when he says: "I think a bystander would say that, tho Christianity had in it something far higher and deeper and more ennobling, yet the average scientific man worships just at present a more awful, and, as it were, a greater deity than the average Christian. In so many Christians the idea of God has been degraded by childish and little-minded teaching; the Eternal and the Infinite and the All-embracing has been represented as the head of the clerical interest, as a sort of clergyman, as a sort of schoolmaster, as a sort of philanthropist. But the scientific man knows him to be eternal; in astronomy, in geology, he becomes familiar with the countless millenniums of his lifetime. The scientific man strains his mind actually to realize God's infinity. As far off as the fixed stars he traces him, 'distance inexpressible by numbers that have name.' Meanwhile, to the theologian, infinity and eternity are very much of empty words when applied to the object of his worship. He does not realize them in actual facts and definite computations" ("Natural Religion," p. 20).—DRUMMOND *Natural Law in the Spiritual World*, essay 4, p. 147. (H. Al.)

1388. GOD WORKS THROUGH SECOND CAUSES—*Beyond the Reach of Science the Fiat and Finger of God.*—"Whatsoever the Lord pleased, that did he in heaven, and in earth, in the seas, and all deep places. He causeth the vapors to ascend from the ends of the earth; he maketh lightnings for the rain; he bringeth the wind out of his treasuries" (Psalm cxxxv. 6-7).

Here, without any change of translation, we are told of the subserviency of the visible instruments to the invisible but real agency of him who wields them at his pleasure. In this passage the winds are plainly represented to us as the messengers of God, and the flaming fire as his servant. He changes no properties and no visible processes—working, not without the wind, but by it—not without the electric matter, but by it—not without the rain, but by it—not without the vapor, but by it. Let the philosopher tell how far back he can go in exploring the method and order of these respective agencies. Then we have only to point further back and ask on what evidence he can tell that the fiat and the finger of a God are not there. We grant the observed order to be invariable, save when God chooses to interpose by miracle. But whether he does or not—from that chamber of his hidden operations which philosophy has not found its way to, can he so direct all, so subordinate all, that whatever the Lord pleases, that does he in heaven and in earth, in the seas, and all deep places.—CHALMERS *Astronomical Discourses*, Suppl. Disc. ii, p. 244. (R. Ct., 1848.)

1389. GOD'S ETERNAL NOW—*The Past of Our Earth May Be Present Fact in Distant Worlds—An Ever-new Present as Light Speeds On.*—Events have happened on our earth and have been forgotten which, nevertheless, are at this very instant of my writing visible from some one or other of the orbs which people space, if only there are creatures on those orbs possessing such enhanced powers of vision as I have spoken of; and there is no event of such a nature as to be visible from standpoints without the earth which has not been thus rendered visible over and over again as the light-messages conveying its history have passed beyond star after star (in all directions from the side of the earth on which such events took place): no such event which will not be thus rendered visible over and over again hereafter as the light-messages travel onwards into the star depths for years, for centuries, for millions on millions of ages, until time shall be no more.

Now, the conception of such powers of vision in creatures made by God's hands may be regarded as fanciful, tho I apprehend that our ideas in such matters are very imperfect and feeble, and afford no measure of what is possible. But that the Almighty himself is cognizant of all these light-messages who can question? To him who is everywhere the light-record of all that has taken place on earth is being continually conveyed, the remembrance is ever present with him, "the eyes of the Lord are in every place beholding the evil and the good" [Prov. xv, 3]; "His eyes are upon the ways of man and he seeth all his goings" [Job xxxiv, 21].—PROCTOR *Expanse of Heaven*, p. 209. (L. G. & Co., 1897.)

1390. GODS OF SAVAGES LIKE THEIR WORSHIPERS—*Cannibal Divinities.*—Their [the Fijian] temples were pyramidal in form, and were often erected on terraced mounds, like those of Central America. They also venerated certain upright stones, resembling those which we call druidical. "The Feegeeans," says Mr. Hazlewood, "consider the gods as beings of like passions with themselves. They love and hate; they are proud and revengeful, and make war, and kill and eat each other, and are, in fact, savages and cannibals like themselves." "Cruelty," says Captain Erskine, "a craving for blood, and especially for human flesh as food, are characteristic of the gods."—AVEBURY *Prehistoric Times*, ch. 13, p. 433. (A., 1900.)

1391. GOLD MAN'S FIRST METAL—*Treasure among Savages—Progress from the Brilliant to the Useful.*—It is probable that gold was the metal which first attracted the attention of man; it is found in many rivers, and by its bright color would certainly strike even the rudest savages, who are known to be very fond of personal decoration. Silver does not appear to have been discovered until long after gold, and was apparently preceded by both copper and tin: for it rarely, if ever, occurs in tumuli of the Bronze Age; but however this may be, copper seems to have been the metal which first became of real importance to man; no doubt owing to the fact that its ores are abundant in many countries, and can be smelted without difficulty; and that, while iron is hardly ever found except in the form of ore, copper often occurs in a native condition, and can be beaten at once into shape. Thus, for instance, the North-American Indians obtained pure copper from the mines near Lake Superior and elsewhere, and hammered it at once into axes, bracelets, and other objects.—AVEBURY *Prehistoric Times*, ch. 1, p. 3. (A., 1900.)

1392. GOOD OUT OF SEEMING EVIL—*Terrible and Destructive Volcanic Forces Part of a Wise Economy.*—It may well be doubted whether the annual average of destruction to life and property caused by all kinds of subterranean action exceeds that produced either by floods or by hurricanes. Yet we know that the circulation of water and air over our globe are beneficial and necessary operations, and that the mischief occasionally wrought by the moving bodies of water and air is quite insignificant compared, with the good which they effect.

In the same way, we shall be able to show that the subterranean energies are necessary to the continued existence of our globe as a place fitted for the habitation of living beings, and that the mischievous and destructive effects of these energies bear but a small and insignificant proportion to the beneficial results with which they must be credited.—JUDD *Volcanoes*, ch. 10, p. 282. (A., 1899.)

1393. GOVERNMENT BY ABSTRACT REASONING—*Plato's "Republic"—Obliteration of Family Life.*—The ancient lawgivers were always aiming at standards of political society framed according to some abstract notions of their own as to how things ought to be, rather than upon any attempt to investigate the constitution of human nature as it actually is. . . . Perhaps, all things considered, the most odious conceptions of human society which the world has ever seen were the conceptions of an intellect certainly among the loftiest which has ever exercised its powers in speculative thought. Plato's Republic is an ideal state, founded on abstract conceptions of the mind, and one of its leading ideas is the destruction of family life and the annihilation of the family affections. And yet this result, odious and irrational as it is, was arrived at from reasoning which is not in itself odious, but which is false, chiefly because it takes no account of the facts of Nature. The welfare of the state was to be the one object of desire in every mind. All separate interests and affections were to be suppressed, and amongst these the very idea of special property in wife or child. The highest type of man was to be bred by the Republic as the highest type of dogs and horses is bred by an intelligent owner. [Grote's "Plato," vol. iii, p. 203.] Such are the humiliating results of abstract reasoning, pursued in ignorance of the great law that no purpose can be attained in Nature except by legitimate use of the means which Nature has supplied. For, as in the material world all her forces must be acknowledged and obeyed before they can be made to serve, so in the realm of mind there can be no success in attaining the highest moral ends until due honor has been assigned to those motives which arise out of the universal instincts of our race.—ARGYLL *Reign of Law*, ch. 7, p. 194. (Burt.)

1394. GOVERNMENT BY PHILOSOPHERS—*Liberty Not To Be Permitted.*—A few words will sufficiently express the outline of [Comte's] scheme. A corporation of philosophers, receiving a modest support from the state, surrounded by reverence, but peremptorily excluded, not only from all political power or employment, but from all riches, and all occupations except their own, are to have the entire direction of education, together with, not only the right and duty of advising and reproving all persons respecting both their public and their private life, but also a control (whether authoritative or only moral is not defined) over the speculative class itself, to prevent them from wasting time and ingenuity on inquiries and speculations of no value to mankind (among which he includes many now in high estimation), and compel them to employ all their powers on the investigations which may be judged, at the time, to be the most urgently important to the general welfare. The temporal

government which is to coexist with this spiritual authority consists of an aristocracy of capitalists, whose dignity and authority are to be in the ratio of the degree of generality of their conceptions and operations—bankers at the summit, merchants next, then manufacturers, and agriculturists at the bottom of the scale. No representative system, or other popular organization, by way of counterpoise to this governing power, is ever contemplated. The checks relied upon for preventing its abuse are the counsels and remonstrances of the spiritual power, and unlimited liberty of discussion and comment by all classes of inferiors. Of the mode in which either set of authorities should fulfil the office assigned to it, little is said in this treatise; but the general idea is, while regulating as little as possible by law, to make the pressure of opinion, directed by the spiritual power, so heavy on every individual, from the humblest to the most powerful, as to render legal obligation, in as many cases as possible, needless. Liberty and spontaneity on the part of individuals form no part of the scheme. M. Comte looks on them with as great jealousy as any scholastic pedagogue, or ecclesiastical director of consciences. Every particular of conduct, public or private, is to be open to the public eye, and to be kept, by the power of opinion, in the course which the spiritual corporation shall judge to be the most right. This is not a sufficiently tempting picture to have much chance of making converts rapidly, and the objections to the scheme are too obvious to need stating.—MILL *Positive Philosophy of Auguste Comte*, p. 110. (H. H. & Co., 1887.)

1395. GOVERNMENT, HARMONIOUS, OF THE UNIVERSE TAUGHT BY ARISTOTLE — *Germ of Undulatory Theory of Light.*—The idea of the harmonious government of the universe reveals itself in a distinct and exalted tone throughout the writings of Aristotle. All the phenomena of Nature are depicted in the "Physical Lectures" ("Auscultationes Physicæ") as moving, vital agents of one general cosmical force. Heaven and Nature (the telluric sphere of phenomena) depend upon the "unmoved motus of the universe." The "ordainer" and the ultimate cause of all sensuous changes must be regarded as something non-sensuous and distinct from all matter. Unity in the different expressions of material force is raised to the rank of a main principle, and these expressions of force are themselves always reduced to motions. Thus we find already in "The Book of the Soul" the germ of the undulatory theory of light. The sensation of sight is occasioned by a vibration—a movement of the medium between the eye and the object seen—and not by emissions from the object or the eye. Hearing is compared with sight, as sound is likewise a consequence of the vibration of the air.—HUMBOLDT *Cosmos*, vol. iii, p. 13. (H., 1897.)

1396. GOVERNMENT, PATERNAL, A BLESSING TO SAVAGES—Like so many other savage races, the North Americans are rapidly disappearing. Left to themselves they would perhaps have developed an indigenous civilization, but for ours they are unfit. Unable to compete with Europeans as equals, and too proud to work as inferiors, they have profited by intercourse with the superior race only where the paternal government of the Hudson's Bay Company has protected them both from the settlers and from themselves, has encouraged hunting, put an end to war, prevented the sale of spirits, and, in times of scarcity, provided food. Erelong almost the only remains of the Indian blood will, perhaps, be found in the territories of the Hudson's Bay Company.—AVEBURY *Prehistoric Times*, ch. 14, p. 505. (A., 1900.)

1397. GRAIN STORED BY ANTS—*Confirmation of Solomon's Observation.*—Sykes, in his account of an Indian ant, *Pheidole providens*, appears to have been the first of modern scientific authors to confirm the statements of Solomon. He states that the above-named species collects large stores of grass-seeds, on which it subsists from February to October. On one occasion he even observed the ants bringing up their stores of grain to dry them after the closing thunder-storms of the monsoon; an observation which has been since confirmed by other naturalists.—AVEBURY *Ants, Bees, and Wasps*, ch. 3, p. 60. (A., 1900.)

1398. GRANDEUR OF THE HUMAN SOUL—*Man, Astronomically Petty, Is Yet Great Enough To Measure the Universe.*—We see that the varied horizons discovered from the height of the elevated paths which the study of astronomy has led us to follow are not less interesting than astronomy itself. The attraction, almost universal, which draws the human mind towards the most abstruse and less usual results of science is, perhaps, the most singular trait of that restless curiosity which has been given to us in order that we may observe and know. Pythagoras was asked what was the characteristic mark of man. He replied, "The knowledge of truth for truth's sake." Is it not remarkable to see the human species, living on the productions of the fostering earth, according to the expression of Homer, applying itself in preference to purely intellectual sciences, and giving to them the greatest part of its attention, to the exclusion of those which have for their object health, feeding, material welfare, and, in short, all the arts without which the powerful organization of modern society cannot subsist? We feel a more lively and profound interest in studying astronomical conquests—as the distance of the stars, the nature of the sun, the planetary humanities, the destinies which await us in infinity and

eternity—than in a new route opened to commerce, a new sort of eatable, or a chemical discovery which may afterwards disturb numerous interests. Thus, of the three elements which form the essence of man—his wants, his affections, and his intelligence—it is the last-named faculty which obtains the preference. It is an advantage, especially to the young, to comprehend in their totality truths the possession of which does honor to the human mind. It is thus that we learn to rise above the petty interests of life, towards the higher regions to which the divine patriotism of the soul aspires.—FLAMMARION *Popular Astronomy*, bk. iii, ch. 7, p. 326. (A.)

1399. GRAVITATION A MYSTERY— *A Mental Inference to Explain Phenomena.*—Yet of the force of gravitation all we know is that it is a force of attraction operating between all the particles of matter in the exact measure which was ascertained by Newton—that is, "directly as the mass, and inversely as the square of the distance." This is the law. But it affords no sort of explanation of itself. What is the cause of this force—what is its source—what are the media of its operation—how is the exact uniformity of its proportions maintained?—these are questions which it is impossible not to ask, but which it is quite as impossible to answer. Sir John Herschel, in speaking of this force, has indicated in a passing sentence a few questions out of the many which arise. "No matter," he says, "from what ultimate causes the power called gravitation originates—be it a virtue lodged in the sun as its receptacle, or be it pressure from without, or the resultant of many pressures, or solicitation of unknown kinds, magnetic or electric, ethers or impulses," etc., etc. How little we have ascertained in this law, after all! Yet there is an immense and an instinctive pleasure in the contemplation of it. To analyze this pleasure is as difficult as to analyze the pleasure which the eye takes in beauty of form, or the pleasure which the ear takes in the harmonies of sound.—ARGYLL *Reign of Law*, ch. 2, p. 44. (Burt.)

1400. ——— ——— *A Statement of Conditions—The Cause Still To Seek—The Falling of an Apple Not Yet Accounted For.*—"Why does an apple fall to the ground?" is a question which has as great a significance to us now as it had before Newton was led, by pondering upon it, to the discovery of the law of gravitation. For that law only expresses the conditions of action of a universal force tending to draw together all masses of matter, while of the force itself it gives no account whatever. We recognize it by our own consciousness of effort in lifting a weight from the ground; and this recognition carries us from the sphere of physical into that of moral causation. For, as Sir John Herschel long ago pointed out, our consciousness of direct personal causation in the performance of a voluntary act leads us to regard what we call the "Forces of Nature" as the emanations of an all-pervading will, and those uniformities in their action which we term her "laws" as the manifestations of its unchanging continuity.—CARPENTER *Nature and Man*, lect. 15, p. 411. (A., 1889.)

1401. GRAVITATION A SIGN OF UNITY—*Moves Whole Mechanism of Heavens.*—There is one sign of unity which, of itself, carries us very far indeed. It is the sign given to us in the ties by which this world of ours is bound to the other worlds around it. There is no room for fancy here. The truths which have been reached in this matter have been reached by walking in the paths of rigorous demonstration. This earth is part of the vast mechanism of the heavens. The force, or forces, by which that mechanism is governed are forces which prevail not only in our own solar system, but, as there is reason to believe, through all space, and are determining, as astronomers tell us, the movement of our sun, with all its planets, round some distant center, of which we know neither the nature nor the place. Moreover, these same forces are equally prevailing on the surface of this earth itself. The whole of its physical phenomena are subject to the conditions which they impose.—ARGYLL *Unity of Nature*, ch. 1, p. 5. (Burt.)

1402. GRAVITATION ENABLES BIRDS TO FLY—*Difference between a Bird and a Balloon.*—It is remarkable that the force which seems so adverse—the force of gravitation drawing down all bodies to the earth—is the very force which is the principal one concerned in flight, and without which flight would be impossible. It is curious how completely this has been forgotten in almost all human attempts to navigate the air. Birds are not lighter than the air, but immensely heavier. If they were lighter than the air they might float, but they could not fly. This is the difference between a bird and a balloon. A balloon rises because it is lighter than the air, and floats upon it. Consequently it is incapable of being directed, because it possesses in itself no active force enabling it to resist the currents of the air in which it is immersed, and because, if it had such a force, it would have no fulcrum, or resisting medium against which to exert it. It becomes, as it were, part of the atmosphere, and must go with it where it goes. No bird is ever for an instant of time lighter than the air in which it flies; but being, on the contrary, always greatly heavier, it keeps possession of a force capable of supplying momentum, and therefore capable of overcoming any lesser force, such as the ordinary resistance of the atmosphere, and even of heavy gales of wind. The law of gravitation, therefore, is used in the flight of birds as one of the most essential of the

forces which are available for the accomplishment of the end in view.—ARGYLL *Reign of Law,* ch. 3, p. 78. (Burt.)

1403. GRAVITATION PROVED UNIVERSAL—*The Work of a Century of Astronomy—Laborious Climbing to Now Familiar Conception.*—The advance of astronomy in the eighteenth century ran in general an even and logical course. The age succeeding Newton's had for its special task to demonstrate the universal validity and trace the complex results of the law of gravitation. The accomplishment of that task occupied just one hundred years. It was virtually brought to a close when Laplace explained to the French Academy, November 19, 1787, the cause of the moon's accelerated motion. As a mere machine, the solar system, so far as it was then known, was found to be complete and intelligible in all its parts; and in the "Mécanique Céleste" its mechanical perfections were displayed under a form of majestic unity which fitly commemorated the successive triumphs of analytical genius over problems among the most arduous ever dealt with by the mind of man.—CLERKE *History of Astronomy,* int., p. 2. (Bl., 1893.)

1404. GRAVITATION SURPASSED BY MOLECULAR FORCES—*Power Involved in Expansion of Iron.*—The constituent molecules of bodies do not touch. It is thus, and thus only, that the expansion and the change of state of bodies under the influence of heat can be explained. We do not doubt the energy of the atomic forces in action around us. Let us heat 1 lb. of iron from 0 to 100 degrees, it will expand about $\frac{1}{800}$, a span imperceptible to the eye, and yet the force which has produced this expansion would be capable of lifting 12,000 lbs., and raising them to the height of one yard. The power of gravitation almost vanishes in comparison with these molecular forces; the attraction exercised by the earth on the weight of half a kilogram (about a pound) taken in a mass is nothing compared to the mutual attraction of its own molecules. In the combination of 1 lb. of hydrogen with 8 lbs. of oxygen to form water, work is performed capable of raising by 1 degree the temperature of 34,000 lbs. of water; or of lifting 15,000,000 lbs. to 1 yard high! These nine pounds of water in being formed have fallen molecularly down a precipice equal to that which would be passed over by a ton of 1,000 kilograms rolling down to 46,000 feet of depth.—FLAMMARION *Popular Astronomy,* bk. iii, ch. 7, p. 320. (A.)

1405. GREED BRINGS DESTRUCTION—*The Puma and Its Prey.*—The puma, after eating its fill, covers the carcass with many large bushes, and lies down to watch it. This habit is often the cause of its being discovered; for the condors, wheeling in the air, every now and then descend to partake of the feast, and being angrily driven away, rise all together on the wing. The Chileno Guaso then knows there is a lion watching his prey—the word is given—and men and dogs hurry to the chase. Sir F. Head says that a Gaucho in the pampas, upon merely seeing some condors wheeling in the air, cried "A lion!"—DARWIN *Naturalist's Voyage around the World,* ch. 12, p. 269. (A., 1898.)

1406. GROWTH AND DECAY PERVADE ALL NATURE—*"In the Beginning."*—"In the beginning God created the heaven and the earth. And the earth was without form, and void."

Whatever our speculations may be in regard to a "beginning," and when it was, it is written in the rocks, that, like the animals and plants upon its surface, the earth itself grew; that for countless ages, measured by years that no man can number, the earth has been gradually assuming its present form and composition, and that the processes of growth and decay are active every hour.—ELISHA GRAY *Nature's Miracles,* vol. i, ch. 1, p. 1. (F. H. & H., 1900.)

1407. GROWTH COMES ONLY FROM LIFE *(Matt. vi, 27)*—*Growth vs. Accretion—Christian Life a Growth.*—A boy not only grows without trying, but he cannot grow if he tries. No man by taking thought has ever added a cubit to his stature; nor has any man by mere working at his soul ever approached nearer to the stature of the Lord Jesus. The stature of the Lord Jesus was not itself reached by work, and he who thinks to approach its mystical height by anxious effort is really receding from it. Christ's life unfolded itself from a divine germ, planted centrally in His nature, which grew as naturally as a flower from a bud. This flower may be imitated; but one can always tell an artificial flower. The human form may be copied in wax, yet somehow one never fails to detect the difference. And this precisely is the difference between a native growth of Christian principle and the moral copy of it. The one is natural, the other mechanical. The one is a growth, the other an accretion.—DRUMMOND *Natural Law in the Spiritual World,* essay 3, p. 114. (H. Al.)

1408. GROWTH, GRADUAL, OF TRUTH—*Sudden Harvest of Discovery—Limited Work of Any Single Discoverer—Total Result Fulfils Divine Plan.*—Slowly, it is true, does the power of the mind give to man the mastery over the more hidden ways of Nature. One after another tries and fails, tho gradually accumulating the knowledge by which, in the end, the secret will be learned. At length the master-mind arrives which is to utilize the garnered knowledge of ages. On a sudden the scattered portions of the chain of evidence are linked together, and the chain is complete. A great work has then been achieved—a work which the Almighty had as fully intended that the human race should accomplish as any of those material successes by which men have ob-

tained mastery over Nature and the forces of Nature.—PROCTOR *Expanse of Heaven,* p. 106. (L. G. & Co., 1897.)

1409. GROWTH OF CORAL, RATE OF —*Anchor Preserved in Coral.*—At the island called Taaopoto, in the South Pacific, the anchor of a ship, wrecked about 50 years before, was observed in seven fathoms of water, still preserving its original form, but entirely incrusted by coral. This fact would seem to imply a slow rate of augmentation; but to form a correct estimate of the average rate must be very difficult, since it must vary not only according to the species of coral, but according to the circumstances under which each species may be placed: such, for example, as the depth from the surface, the quantity of light, the temperature of the water, its freedom from sand or mud, or the absence or presence of breakers, which is favorable to the growth of some kinds and is fatal to that of others.—LYELL *Principles of Geology,* ch. 50, p. 778. (A., 1854.)

1410. ——— ——— *Experiment to Determine.*—To ascertain the rise and progress of the coral family, and fix the number of species met with at Foul Point (lat. 17° 40′), twenty species of coral were taken off the reef and planted apart on a sandbank three feet deep at low water. Each portion weighed ten pounds, and was kept in its place by stakes. Similar quantities were placed in a clump and secured as the rest. This was done in December, 1830. In July following, each detached mass was nearly level with the sea at low water, quite immovable, and several feet long, stretching, like the parent reef, in the line of the coast-current from north to south. The masses accumulated in a clump were found equally increased, but some of the species in such unequal ratios as to be growing over each other. [Quoted from MS. thesis of Dr. Allan, of Forres, deposited in the library of Edinburgh University.]—DARWIN *Coral Reefs,* ch. 4, p. 104. (A., 1900.)

1411. GROWTH OF ELECTRIC AND MAGNETIC DISCOVERY—*A True Intellectual Rise.*—After the lapse of centuries a new capacity of the lodestone became revealed in its polarity, or the appearance of opposite effects at opposite ends; then came the first utilization of the knowledge thus far gained, in the mariner's compass, leading to the discovery of the New World, and the throwing wide of all the portals of the Old to trade and civilization.

The predominance of the magnet in human thought was yielded to the amber, when the strange power of the latter was found to exist also in other things. The keen-eyed discoverers saw this new force annihilate time and space, and flash into light; pursued it even to its hiding-place in the clouds; beheld it grow from the feeble amber-soul into the mighty thunderbolt; watched it until the whole universe showed itself pervaded with it.

This was a true intellectual rise. It was the intellect at work building the universe of which it is the key; finding anew that Nature also is working in every detail after the laws of the human mind.—PARK BENJAMIN *Intellectual Rise in Electricity,* int., p. 13. (J. W., 1898.)

1412. GROWTH OF LOYALTY, HEROISM, AND PATRIOTISM—As the maternal instinct had been cultivated for thousands of generations before clanship came into existence, so for many succeeding ages of turbulence the patriotic instinct, which prompts to the defense of home, was cultivated under penalty of death. Clans defended by weakly loyal or cowardly warriors were sure to perish. Unflinching bravery and devoted patriotism were virtues necessary to the survival of the community, and were thus preserved until at the dawn of historic times, in the most grandly militant of clan societies, we find the word *virtus* connoting just these qualities, and no sooner does the fateful gulf yawn open in the forum than a Curtius joyfully leaps into it, that the commonwealth may be preserved from harm.—FISKE *Through Nature to God,* pt. ii, ch. 9, p. 104. (H. M. & Co., 1900.)

1413. GROWTH, SLOW, OF PATERNAL VIRTUES—*Bird Parents United in Love—Little Fatherhood among Mammalia—Among Carnivora Fathers Dangerous to Their Offspring.*—If maternity was at a feeble level in the lower reaches of Nature, paternity was non-existent. Among a few invertebrates the male parent took a passing share in the care of the egg, but it is not until we are all but at the top that fatherly interest finds any real expression. Among the birds, the parents unite together in most cases to build the nest, the father doing the rough work of bringing in moss and twigs, while the more trusty mother does the actual work. When the eggs are laid, the male parent also takes his turn at incubation; supplies food and protection, and lingers round the place of birth to defend the fledglings to the last. When we leave the birds, however, and pass on to the mammals, the fathers are nearly all backsliders. Many are not only indifferent to their young, but hostile; and among the carnivora the mothers have frequently to hide their little ones [lest the father should eat them].—DRUMMOND *Ascent of Man,* ch. 9, p. 294. (J. P., 1900.)

1414. GULF ASSUMED BETWEEN MAN AND NATURE—*The Human Mind a Part of Nature.*—It [the charge of anthropomorphism] assumes that the relation between the human mind and the system of Nature in which we live is fundamentally a relation of contrast and not of harmony—a relation of difference so deep and so complete that the intellectual impressions

which Nature gives to us are not presumably right, but, on the contrary, are presumably wrong. . . . Man is no part of Nature. His mind does not reflect her laws. On the contrary, his intellect is separated by such a gulf from those laws that it tends of necessity to misinterpret and misconceive them. The very forms in which our perceptions and our conceptions are molded are forms which [are assumed to] have no counterpart outside the organism through which we see and think.—ARGYLL *Unity of Nature*, ch. 5, p. 102. (Burt.)

1415. GULF BETWEEN MAN AND BRUTE—No one is more strongly convinced than I am of the vastness of the gulf between civilized man and the brutes; or is more certain that whether *from* them or not, he is assuredly not *of* them. No one is less disposed to think lightly of the present dignity, or despairingly of the future hopes, of the only consciously intelligent denizen of this world.—HUXLEY *Man's Place in Nature*, p. 234. (Hum.)

1416. GULF BETWEEN ORGANIC AND INORGANIC—Between the living and the non-living there is a great gulf fixed; and the indissoluble connection which somehow, nevertheless, we know to exist between them is a connection which does not fill up that gulf, but is kept up by some bridge being, as it were, artificially built across it. This unity, like the other unities of nature, is not a unity consisting of mere continuity of substance. It is not founded upon sameness, but, on the contrary, rather upon difference, and even upon antagonisms.—ARGYLL *Unity of Nature*, ch. 2, p. 33. (Burt.)

1417. GULF STREAM, INFLUENCE OF—*Moderates Climate of Western Europe.*—But the effects of the Gulf Stream on the climate of the North Atlantic Ocean are far more remarkable. This most powerful of known currents has its source in the Gulf or Sea of Mexico, which, like the Mediterranean and other close seas in temperate or low latitudes, is warmer than the open ocean in the same parallels. The temperature of the Mexican sea in summer is, according to Rennel, 86° F., or at least 7° above that of the Atlantic in the same latitude. From this great reservoir or caldron of warm water a constant current pours forth through the Straits of Bahama at the rate of 3 or 4 miles an hour; it crosses the ocean in a northeasterly direction, skirting the great Bank of Newfoundland, where it still retains a temperature of 8° above that of the surrounding sea. It reaches the Azores in about 78 days, after flowing nearly 3,000 geographical miles, and from thence it sometimes extends its course a thousand miles farther, so as to reach the Bay of Biscay, still retaining an excess of 5° above the mean temperature of that sea. As it has been known to arrive there in the months of November and January, it may tend greatly to moderate the cold of winter in countries on the west of Europe.—LYELL *Principles of Geology*, bk. i, ch. 7, p. 95. (A., 1854.)

1418. HABIT A RESULT OF BODILY ORGANISM—I believe that we are subject to the law of habit in consequence of the fact that we have bodies. The plasticity of the living matter of our nervous system, in short, is the reason why we do a thing with difficulty the first time, but soon do it more and more easily, and finally, with sufficient practise, do it semi-mechanically, or with hardly any consciousness at all. Our nervous systems have (in Dr. Carpenter's words) *grown* to the way in which they have been exercised, just as a sheet of paper or a coat, once creased or folded, tends to fall forever afterward into the same identical folds. Habit is thus a second nature.—JAMES *Talks to Teachers*, ch. 8, p. 65. (H. H. & Co., 1900.)

1419. HABIT BEST CONQUERED BY SHARP AND SUDDEN CHANGE—*"Tapering-off" Rarely Practicable.*—The question of "tapering-off," in abandoning such habits as drink and opium-indulgence, comes in here, and is a question about which experts differ within certain limits, and in regard to what may be best for an individual case. In the main, however, all expert opinion would agree that abrupt acquisition of the new habit is the best way, *if there be a real possibility of carrying it out.* We must be careful not to give the will so stiff a task as to insure its defeat at the very outset; but, *provided one can stand it,* a sharp period of suffering, and then a free time, is the best thing to aim at, whether in giving up a habit like that of opium, or in simply changing one's hours of rising or of work. It is surprising how soon a desire will die of inanition if it be *never* fed.—JAMES *Psychology*, vol. i, ch. 4, p. 124. (H. H. & Co., 1899.)

1420. HABIT, HEREDITY OF—*Horses, Dogs, and Birds, Apparent Heredity among.*—Darwin says, "A horse is trained to certain paces, and the colt inherits similar consensual movements." But selection of the constitutional tendency to these paces, and imitation of the mother by the colt, may have been the real causes. The evidence, to be satisfactory, should show that such influences were excluded. Men acquire proficiency in swimming, waltzing, walking, smoking, languages, handicrafts, religious beliefs, etc., but the children only appear to inherit the innate abilities or constitutional proclivities of their parents. Even the songs of birds, including their call-notes, are no more inherited than is language by man ("Descent of Man," p. 47). They are learned from the parent. Nestlings, which acquire the song of a distinct species, "teach and transmit their new song to their offspring." If use-inheritance has not fixed the song of birds, why should we suppose that in a single generation it has transmitted a new-

ly taught method of walking or trotting? It is alleged that dogs inherit the intelligence acquired by association with man, and that retrievers inherit the effects of their training. But selection and imitation are so potent that the additional hypothesis of use-inheritance seems perfectly superfluous. Where intelligence is not highly valued and carefully promoted by selection, the intelligence derivable from association with man does not appear to be inherited. Lap-dogs, for instance, are often remarkably stupid.—BALL *Are the Effects of Use and Disuse Inherited?* p. 31. (Hum., 1891.)

1421. HABIT, HYPNOTIC, FASCINATION OF—Frequent hypnotizing may lead in the long run to an irresistible passion for the hypnotic sleep, in which case the impulse to obtain it acts like the morphin habit or habituation to any particular stimulant or sedative. The confirmed hypnotic will try in every possible way to procure the enjoyment which he craves.—WUNDT *Psychology*, lect. 22, p. 331. (Son. & Co., 1896.)

1422. HABIT, IMPERIOUSNESS OF—*Unconscious Profanity—Anecdote of Military Officer.*—The following case, recently communicated to the writer, shows how strongly the mode of expression of our ideas is influenced by habit; and how, after the chain would seem to have been completely broken, it may come to renew itself when the circumstances recur under which it had been formed:

A military officer, who had seen much hard service at a time when a command was scarcely ever given without the accompaniment of an oath, and who had thus acquired the habit of continual swearing, determined, on retiring into private life, to do his best to forego this practise; and by keeping a constant check upon himself, with the assistance of the friendly monitions of others, he entirely succeeded. After the lapse of many years, however, he found himself called upon to perform some military duty; and, in the discharge of it, he used much of the bad language to which he had formerly accustomed himself. A friend who happened to notice this, having afterwards expressed his regret that he should have relapsed into his old habit of swearing, the officer assured him (and he was a man whose word could be implicitly relied on) that he was not at the time in the least degree conscious of uttering an oath, and that he had not the slightest recollection of having done so.—CARPENTER *Mental Physiology*, bk. i, ch. 6, p. 282. (A., 1900.)

1423. HABIT OF DOING RIGHT—*Preparation for Instantaneous Action—The Habits of a Nation.*—I consider the great object of intellectual education to be, not only to teach the pupils how to *think*, but how to *act* and to *do*, and I place great stress upon the early education of the *habits*. And this kind of training may be extended beyond the mental processes to the moral principles; the pupil may be taught on all occasions habitually and promptly, almost without thought, to act properly in any case that may occur, and this in the practical duties of life is of the highest importance. We are frequently required to act from the impulse of the moment, and have no time to deduce our course from the moral principles of the act. An individual can be educated to a strict regard for truth, to deeds of courage in rescuing others from danger, to acts of benevolence, of generosity, and justice; or, on the other hand, tho his mind may be well stored with moral precepts, he may be allowed to fall into opposite habits alike prejudicial to himself and to those with whom he is associated. He may "know the right, and yet the wrong pursue."

Man is the creature of habit; it is to him more than second nature; but unfortunately, while bad habits are acquired with readiness, on account of the natural desire to gratify our passions and appetites, good habits can only be acquired by unremitting watchfulness and labor. The combined habits of individuals form the habits of a nation, and these can only be molded . . . by the coercive labor of the instructor judiciously applied.—HENRY *Thoughts on Education (Scientific Writings*, vol. i, p. 340). (Sm. Inst., 1886.)

1424. HABITAT, ADAPTATION OF ANIMALS TO—*Protective Mimicry.*—Even the popular mind has been struck with the curious adaptation of nearly all animals to their habitat, for example in the matter of color. The sandy hue of the sole and flounder, the white of the polar bear, with its suggestion of arctic snows, the stripes of the Bengal tiger—as if the actual reeds of its native jungle had nature-printed themselves on its hide—these, and a hundred others which will occur to every one, are marked instances of adaptation to environment induced, by natural selection or otherwise, for the purpose, obviously in these cases at least, of protection.—DRUMMOND *Natural Law in the Spiritual World*, essay 7, p. 233. (H. Al.)

1425. HABITAT OF HUMMING-BIRDS—*Species Limited to a Single Mountain.*—In contrast with these species of extended range, there are many species [of humming-birds] whose habitat is confined, perhaps, to a single mountain, and there are a few which never have been seen beyond the edges of some extinct volcano, whose crater is now filled with a special flora. Many of the great mountains of the Andes have each of them species peculiar to themselves. On Chimborazo and Cotopaxi, and other summits, special forms of humming-birds are found in special zones of vegetation even close up to the limits of perpetual snow.

Again, many of the islands have species peculiar to themselves. The little island of Juan Fernandez, 300 miles from the mainland, has three species peculiar to itself, of which two are so distinct from all others known that they cannot for a moment be confounded with any of them.—ARGYLL *Reign of Law,* ch. 5, p. 135. (Burt.)

1426. HABITS FIXED IN YOUTH—*All Later Life Dependent on Early Years.*—If a boy grows up alone at the age of games and sports, and learns neither to play ball, nor row, nor sail, nor ride, nor skate, nor fish, nor shoot, probably he will be sedentary to the end of his days; and, tho the best of opportunities be afforded him for learning these things later, it is a hundred to one but he will pass them by and shrink back from the effort of taking those necessary first steps the prospect of which, at an earlier age, would have filled him with eager delight. The sexual passion expires after a protracted reign; but it is well known that its peculiar manifestations in a given individual depend almost entirely on the habits he may form during the early period of its activity. Exposure to bad company then makes him a loose liver all his days; chastity kept at first makes the same easy later on.—JAMES *Psychology,* vol. ii, ch. 24, p. 401. (H. H. & Co., 1899.)

1427. HABITS, GOOD AS WELL AS BAD—The fact is that our virtues are habits as much as our vices. All our life, so far as it has definite form, is but a mass of habits—practical, emotional, and intellectual—systematically organized for our weal or woe, and bearing us irresistibly toward our destiny, whatever the latter may be.—JAMES *Talks to Teachers,* ch. 8, p. 64. (H. H. & Co., 1900.)

1428. HABITS SHOW MAN'S COMPOSITE NATURE—There is no part of man's composite nature in which the intimate relation between mind and body is more obvious than it is in the formation of habitual modes of activity, whether psychical or corporeal; the former, like the latter, being entirely conformable to the laws which express the ordinary course of the nutritive operations.—CARPENTER *Mental Physiology,* bk. i, ch. 8, p. 337. (A., 1900.)

1429. HAECKEL AND MONISM—*Body without a Soul—Universe without a Spirit.*—Ernst Haeckel is an eminent comparative anatomist and physiologist, who has earned a wide and deserved reputation by his able and laborious studies of the calcareous sponges, the radiolarians, and other low forms of life. . . . He is not merely an evolutionist, but what he terms a "monist," and the monistic philosophy, as defined by him, includes certain negations and certain positive principles of a most comprehensive and important character. It implies the denial of all spiritual or immaterial existence. Man is to the monist merely a physiological machine, and Nature is only a greater self-existing and spontaneously moving aggregate of forces. Monism can thus altogether dispense with a creative will as originating Nature, and adopts the other alternative of self-existence or causelessness for the universe and all its phenomena. Again, the monistic doctrine necessarily implies that man, the animal, the plant, and the mineral are only successive stages of the evolution of the same primordial matter, constituting thus a connected chain of being, all the parts of which sprang spontaneously from each other. Lastly, as the admixture of primitive matter and force would itself be a sort of dualism, Haeckel regards these as ultimately one, and apparently resolves the origin of the universe into the operation of a self-existing energy having in itself the potency of all things. After all, this may be said to be an approximation to the idea of a Creator, but not a living and willing Creator.—DAWSON *Facts and Fancies in Modern Science,* lect. 1, p. 54. (A. B. P. S.)

1430. HALF-TRUTH, A, TERRIFIES—*Biela's Comet Crosses the Earth's Orbit—False Alarm Given by Pseudo-science.*—In calculating the epoch of the reappearance of the new body [Biela's comet], Damoiseau had found that the comet would, on October 29, 1832, before midnight, cross the plane in which the earth moves at the only place where a comet would be likely to encounter the earth. The passage of the body would, according to calculation, take place in the plane, but a little inside the earth's orbit, and at a distance equal to four and two-thirds terrestrial radii. As the length of the comet's radius was equal to five and one-third terrestrial radii, it was probable from all the evidence that on October 29, 1832, before midnight, a part of the terrestrial orbit would be occupied by the comet.

These results, supported by all desirable scientific authority, were brought by the newspapers to the notice of the public; we may imagine the profound sensation which they produced. It was a fact! the end of time was near! the earth was about to be shattered, pulverized, annihilated by the shock of the comet! Such was the subject of all conversation. The strongest minds were for a moment disturbed.

But a question remained to be asked, and the newspapers had neither stated it nor even anticipated it. At what place in its immense orbit would the earth be found on October 29, 1832, before midnight, at the moment when the comet would cross this orbit at one of its nodes? Calculation very quickly settled this difficulty. Arago wrote in the *Annuaire* for 1832: "The passage of the comet will take place very near *a certain point* of the terrestrial orbit on October 29, before midnight; well, the earth will not reach the *same point* till the morning of November 30—that is to say, *more than a*

month after. We have now only to recollect that the mean velocity of the earth in its orbit is 1,670,000 miles a day, and a very simple calculation will prove that *the comet will pass at fifty millions of miles from the earth.*"—FLAMMARION *Popular Astronomy*, bk. v, ch. 1, p. 483. (A.)

1431. HALLUCINATION PRODUCED BY ACONITE—*Unreality Recognized.*—[The following incident] is recorded of himself by Dr. Laycock:

"On a certain night, when a sufferer from severe pain and great weakness, he took one drop of Fleming's tincture of aconite, and slept. About midnight he became sensible of a novel state of perception, obscure at first, but shaped at last into strains of grand aerial music in cadences of exquisite harmony, now dying away round mountains in infinite perspective, now pealing along oceanlike valleys. Knowing by previous studies that it was a hallucination of perception, he at last listened to ascertain the cause, and found it was the rattle of a midnight train entering an adjoining railway station. Thus, under the changes induced in the brain by a drop of tincture of aconite, the harsh rattle of the iron vibrating on the air in the silence of a summer midnight was changed into harplike aerial music, such not only as 'ear had not heard.' but no conceivable art of man could realize. Associated therewith was also a suggested terrestrial vision of space of infinite extent and grandeur."—CARPENTER *Mental Physiology*, bk. ii, ch. 17, p. 643. (A., 1900.)

1432. HAMMER A RELIC OF STONE AGE—*History Preserved in Its Name.*—While the club has been generally a weapon, the hammer has been generally an implement. Its history begins with the smooth heavy pebble held in the hand, such as African blacksmiths to this day forge their iron with, on another smooth stone as anvil. It was a great improvement to fasten the stone hammer on a handle; this was done in very ancient times, as is seen by the stone heads being grooved or bored on purpose. . . . Tho the iron hammer has superseded these, a trace of the older use of stone remains in our very name *hammer*, which is the old Scandinavian *hamarr*, meaning both rock and hammer.—TYLOR *Anthropology*, ch. 8, p. 184. (A., 1899.)

1433. HAND GIVES MAN PREEMINENCE—*The Use of the Hands Develops the Intellect.*—How far the value of the hand as a mechanical instrument depends on this opposability [of the thumb, found only in the human hand], any one may satisfy himself by using his hand with the thumb stiff. It is plain that man's hand, enabling him to shape and wield weapons and tools to subdue Nature to his own ends, is one cause of his standing first among animals. It is not so obvious, but it is true, that his intellectual development must have been in no small degree gained by the use of his hands. From handling objects, putting them in different positions, and setting them side by side, he was led to those simplest kinds of comparing and measuring which are the first elements of exact knowledge, or science. —TYLOR *Anthropology*, ch. 2, p. 43. (A., 1899.)

1434. HAPPINESS INVOLVES AN ELEMENT OF PAIN—*Love Makes Sacrifice Painless.*—In our best happiness, then, what we otherwise term pain is swallowed up. It is embodied and mixed up in the joy. For do we not despise and loathe a man whose only thought in that which he calls love is of the pleasure he can receive? And, further, by taking away the love, its sacrifices would be felt as pain: pain emerges, or comes out, from this joy by a taking away, or absence. And its presence, to one who should be loving, might imply no evil state around him, but only something wanting in himself. For the very same things may be to us either painful, or in the highest degree productive of delight, of a delight which could not be without them.—HINTON *The Mystery of Pain*, p. 21. (Hum., 1893.)

1435. HAPPINESS VS. PERFECTED CHARACTER—A world of completed happiness might well be a world of quiescence, of stagnation, of automatism, of blankness; the dynamics of evolution would have no place in it. But suppose we say that the ultimate goal of the ethical process is the perfecting of human character? This form of statement contains far more than the other. Consummation of happiness is a natural outcome of the perfecting of character, but that perfecting can be achieved only through struggle, through discipline, through resistance. It is for him that overcometh that the crown of life is reserved. The consummate product of a world of evolution is the character that creates happiness, that is replete with dynamic possibilities of fresh life and activity in directions forever new. Such a character is the reflected image of God, and in it are contained the promise and potency of life everlasting. —FISKE *Through Nature to God*, pt. ii, ch. 9, p. 115. (H. M. & Co., 1900.)

1436. HARBORS FORMED BY CORAL REEFS—*Great Prospective Value.*—The harbors which are produced by the reef-building corals, together with the various marine animals and plants which are associated with them, are among the most interesting and important of all classes of havens. They are not only in origin the most peculiar of all inlets of the sea, but the conditions of their development and the circumstances which lead to their preservation and destruction are also curious and noteworthy. Moreover, in the district of southern Florida organic reefs of this nature are numerous and extensive, and the ports which they form, tho as yet relatively little used, are destined in course of time to have great value to this country.—SHALER *Sea and Land* p. 203. (S., 1894.)

1437. HARMONY AMID DIVERSITY —*Relative Size of Sun and Planets—Great and Small in Balanced Movement.*—Let the reader consider a terrestrial globe three inches in diameter, and search out on that globe the tiny triangular speck which represents Great Britain. Then let him endeavor to picture the town in which he lives as represented by the minutest pin-mark that could possibly be made upon this speck. He will then have formed some conception, tho but an inadequate one, of the enormous dimensions of the earth's globe, compared with the scene in which his daily life is cast. Now, on the same scale, the sun would be represented by a globe about twice the height of an ordinary sitting-room. A room about twenty-six feet in length, and height, and breadth, would be required to contain the representation of the sun's globe on this scale, while the globe representing the earth could be placed in a moderately large goblet.

Such is the body which sways the motions of the solar system. The largest of his family, the giant Jupiter, tho of dimensions which dwarf those of the earth or Venus almost to nothingness, would yet only be represented by a thirty-two-inch globe on the scale which gives to the sun the enormous volume I have spoken of. Saturn would have a diameter of about twenty-eight inches, his ring measuring about five feet in its extreme span. Uranus and Neptune would be little more than a foot in diameter, and all the minor planets would be less than the three-inch earth. . . . The sun outweighs fully 730 times the combined mass of all the planets which circle around him.—PROCTOR *Other Worlds than Ours*, ch. 2, p. 33. (Burt.)

1438. HARMONY OF NATURE—*Ancient and Recent Features of Landscape Perfectly Blend.*—There is nothing, indeed, so calculated to instruct the geologist as the striking manner in which the recent volcanic hills of Ischia . . . blend with the surrounding landscape. Nothing seems wanting or redundant; every part of the picture is in such perfect harmony with the rest that the whole has the appearance of having been called into existence by a single effort of creative power. Yet what other result could we have anticipated if Nature has ever been governed by the same laws? Each new mountain thrown up—each new tract of land raised or depressed by earthquakes—should be in perfect accordance with those previously formed.—LYELL *Principles of Geology*, bk. ii, ch. 23, p. 373. (A., 1854.)

1439. ——— ——— *Gravity and the Flowers—The Whole Earth Enlisted To Hold the Snowdrop in Position—Our Flowers Could Not Grow on Mars.*—Another illustration, and a very beautiful one, is pointed out by Whewell in the positions of flowers. "Some flowers grow with the hollow of their cup upwards; others 'hang the pensive head' and turn the opening downwards." It is obvious that an increase of gravity would force the upright plants to hang their heads, while a decrease to the value of gravity which actually exists in Mars would cause the drooping heads to stand erect. But it has been shown by Linnæus that on the position of the heads of flowers, combined with the greater or less length of the pistil and stamens, depends the fertility of the plant. So that, as Whewell remarks, "the whole mass of the earth, from pole to pole, and from circumference to center, is employed in keeping a snowdrop in the position most suited to the promotion of its vegetable health."—PROCTOR *Expanse of Heaven*, p. 72. (L. G. & Co., 1897.)

1440. HARMONY OF NATURE AND OF THE HUMAN MIND—How can it be true that man is so outside of that unity [of Nature] that the very notion of seeing anything like himself in it is the greatest of all philosophical heresies? Does not the very possibility of science consist in the possibility of reducing all natural phenomena to purely natural conceptions, which must be related to the intellect of man when they are worked out and apprehended by it? And if, according to the latest theories, man is himself a product of evolution, and is, therefore, in every atom of his body and in every function of his mind a part and a child of Nature, is it not in the highest degree illogical so to separate him from it as to condemn him for seeing in it some image of himself? If he is its product and its child, is it not certain that he is right when he sees and feels the indissoluble bonds of unity which unite him to the great system of things in which he lives?—ARGYLL *Unity of Nature*, ch. 8, p. 165. (Burt.)

1441. HARMONY OF THE UNIVERSE —*Gravitation Proved Universal — Discovery of Neptune—Newton Finds a Law—The Law Enables Astronomers To Find an Unknown World.*—This discovery [of Neptune] seems to me in some respects even more striking than Newton's discovery of the law of gravitation. Newton explained the laws according to which known objects move; Adams and Le Verrier showed where a hitherto unknown object would be found when telescopes were turned to that part of the heavens. Newton recognized laws hitherto unknown. Adams and Le Verrier by abstract reasoning inferred the existence of a world which men as yet had never seen.—PROCTOR *Expanse of Heaven*, p. 122. (L. G. & Co., 1897.)

1442. HARP DERIVED FROM BOWSTRING—*The Piano a Perfected Harp.*—It is told in the "Odyssey" (xxi. 410) how the avenging hero, when he has strung his mighty bow compact of wood and horn, gives the stretched string a twang that makes it sing like a swallow in a soft tone

beautifully. One might well guess that the strung bow of the warrior would naturally become a musical instrument, but, what is more, it really is so used. The Damara in South Africa finds pleasure in the faint tones heard by striking the tight bowstring with a little stick. The Zulu despises the bow as a cowardly weapon, but he still uses it for music; his music-bow has a ring slid along the string to alter the note, and is also provided with a hollow gourd [held behind the bow against the breast] acting as a resonator or sounding-box to strengthen the feeble twang. The ancient Egyptian harp [simply a curved strip of wood, with a few strings stretched across it] may have been developed from such a rude music-bow, the wooden back being now made hollow so as to be bow and resonator in one, while across it are strung several strings of different lengths. All ancient harps, Assyrian, Persian, even old Irish, were made on this plan, yet we can see at a glance that it was defective, the bending of the wooden back putting the strings out of tune. It was not till modern ages that the improvement was made of completing the harp with the front pillar, which makes the whole frame rigid and firm. . . . The harp, tho now made more perfect than of old, is losing its ancient place in music; but the reason of this is easy to see—it has been supplanted by modern instruments which have come from it. The very form of a grand piano shows that it is a harp laid on one side in a case, and its strings not plucked with the fingers, but struck with hammers worked from a keyboard. It is the latest development from the bowstring of the prehistoric warrior.—TYLOR *Anthropology*, ch. 12, p. 295. (A., 1899.)

1443. HARVEST, GREAT, FROM SCANTY SOWING—*Few Original Concepts in Sanskrit—All India's Languages Therefrom.*—In analyzing the Sanskrit language, Professor Max Müller ["Science of Thought," p. 549] reduces its whole vocabulary to 121 roots—the 121 "original concepts." "These 121 concepts constitute the stock-in-trade with which I maintain that every thought that has ever passed through the mind of India, so far as known to us in its literature, has been expressed. It would have been easy to reduce that number still further, for there are several among them which could be ranged together under more general concepts. But I leave this further reduction to others, being satisfied as a first attempt with having shown how small a number of seeds may produce, and has produced, the enormous intellectual vegetation that has covered the soil of India from the most distant antiquity to the present day."—DRUMMOND *Ascent of Man*, ch. 5, p. 180. (J. P. & Co., 1900.)

1444. HAWAII, VOLCANOES OF—*Vast River of Melted Rock—Mauna Loa.*—We learn from the valuable observations made by Mr. Dana on the active volcanoes of the Sandwich Islands, that large sheets of compact basaltic lava have been poured out of craters at the top or near the summits of flattened domes higher than Etna, as in the case of Mount Loa, for example, where a copious stream two miles broad and twenty-five miles long proceeded from an opening 13,000 feet above the level of the sea. The usual slope of these sheets of lava is between 5° and 10°; but Mr. Dana convinced himself that, owing to the suddenness with which they cool in the air, some lavas may occasionally form on slopes equaling 25°, and still preserve a considerable compactness of texture. It is even proved, he says, from what he saw in the great lateral crater of Kilauea, on the flanks of Mount Loa, that a mass of such melted rock may consolidate at an inclination of 30°, and be continuous for 300 or 400 feet. Such masses are narrow, he admits, "but if the source had been more generous, they would have had a greater breadth, and by a succession of ejections, overspreading each cooled layer, a considerable thickness might have been attained." The same author has also shown . . . that in the "cinder cones" of the Sandwich Islands the strata have an original inclination of between 35° and 40°.—LYELL *Principles of Geology*, bk. ii, ch. 24, p. 383. (A., 1854.)

1445. HAWK THE FARMER'S ALLY—"*Chicken-hawk*" *Lives Chiefly on Mice and Batrachians and Insects.*—The voices of hawks are in keeping with their dispositions, and, while their lives typify all that is fierce and cruel, no birds are more often wrongly accused and falsely persecuted than our birds of prey. To kill one is regarded as an act of special merit; to spare one seems to place a premium on crime. Still, these birds are among the best friends of the farmer. There are but two of our common species, Cooper's and the sharp-shinned, who habitually feed on birds and poultry. Our other common species are, without exception, invaluable aids to the agriculturist in preventing the undue increase of the small rodents so destructive to crops. . . .

The red-shouldered hawk, to which the name chicken- or hen-hawk is often applied, has been found to live largely on small mammals, reptiles, batrachians, and insects.—CHAPMAN *Bird-Life*, ch. 7, p. 116. (A., 1900.)

1446. HEALTH BY REMOVAL OF IMPURITIES—*The Elbe below Hamburg.*—In 1893 Koch brought out his monograph upon "Water Filtration and Cholera," and his work had a deservedly great influence upon the whole question. He shows how the careful filtration of water supplied to Altona from the Elbe saved the town from the epidemic of cholera which came upon Hamburg as a result of drinking unfiltered water, altho Altona is situated several miles

below Hamburg, and its drinking-water is taken from the river after it has received the sewage of Hamburg.—NEWMAN *Bacteria*, ch. 2, p. 75. (G. P. P., 1899.)

1447. HEALTH CONDUCES TO MORALITY—*Interaction of Matter and Spirit.*—There is assuredly morality in the oxygen of the mountains, as there is immorality in the miasma of a marsh, and a higher power than mere brute force lies latent in Alpine mutton. We are recognizing more and more the influence of physical elements in the conduct of life, for when the blood flows in a purer current the heart is capable of a higher glow. Spirit and matter are interfused; the Alps improve us totally, and we return from their precipices wiser as well as stronger men.—TYNDALL *Hours of Exercise in the Alps*, ch. 14, p. 155. (A., 1898.)

1448. HEALTH IN TROPICAL LANDS—*Danger of Excesses in Food—Alcoholic Stimulants Perilous.*—Englishmen, accustomed to an active life at home, and a climate demanding much fuel-food for the maintenance of animal heat, go to India, crammed, maybe, with Latin, but ignorant of the laws of health; cheap servants promote indolence, tropical heat diminishes respiratory oxidation, and the appetite naturally fails.

Instead of understanding this failure as an admonition to take smaller quantities of food, or food of less nutritive and combustive value, such as carbohydrates instead of hydrocarbons and albuminoids, they regard it as a symptom of ill-health, and take curries, bitter ale, and other tonics or appetizing condiments, which, however mischievous in England, are far more so here.

I know several men who have lived rationally in India, and they all agree that the climate is especially favorable to longevity, provided bitter beer and all other alcoholic drinks, all peppery condiments, and flesh foods are avoided. The most remarkable example of vigorous old age I have ever met was a retired colonel eighty-two years of age, who had risen from the ranks, and had been fifty-five years in India without furlough; drunk no alcohol during that period; was a vegetarian in India, tho not so in his native land. I guessed his age to be somewhere about sixty. He was a Scotchman, and an ardent student of the works of both George and Dr. Andrew Combe.—WILLIAMS *Chemistry of Cookery*, ch. 15, p. 261. (A., 1900.)

1449. HEARING, SENSE OF, IN BEES—*Seemingly Too Fine for Human Discernment.*—As in ants, so in bees, Sir John [Lubbock's] experiments failed to yield any evidence of a sense of hearing. But in this connection we must not forget the well-known fact, first observed by Huber, that the queen bee will answer by a certain sound the peculiar piping of a pupa queen; and again, by making a certain cry or humming noise, will strike consternation suddenly on all the bees in the hive—these remaining for a long time motionless as if stupefied.—ROMANES *Animal Intelligence*, ch. 4, p. 144. (A., 1899.)

1450. HEARTH AS TYPE OF HOME—*Wood as Fuel—Exhaustion of—The Indian's Guess.*—When in the savage hut the logs are piled on the earthen floor, this simple hearth already becomes the gathering-place of the family and the type of home. But in treeless districts the want of fuel is one of the difficulties of life, as where on the desert plains the buffalo-hunter has to pick up for the evening fire the droppings which he calls "buffalo-chips" or *bois de vache*. Even in woodland countries, as soon as people collect in villages, the fire-wood near by is apt to run short. When some American Indians were asked what reason they supposed had brought the white men to their country, they answered quite simply that no doubt we had burnt up all our wood at home and had to move. The guess was so far good that something of the kind must really have happened had we depended on the fuel from our forests and peat-bogs, for the supply in England was giving out.—TYLOR *Anthropology*, ch. 11, p. 270. (A., 1899.)

1451. HEAT A MODE OF MOTION—*Recent Theory Foreshadowed.*—By this corpuscular or mechanical philosophy Boyle [1626-1692] explains such things as he regards as natural phenomena—such as heat and cold, tastes, corrosiveness, fixedness, volatility, chemical precipitation, and, finally, magnetism and electricity. Thus, heat, he says, is "that mechanical affection of matter we call local motion, mechanically modified" in three ways: first, by the vehement agitation of the parts; second, that the motions be very various in direction; and third, that the agitated particles, or at least the greatest number of them, be so minute as to be singly insensible.

It is singular how the mechanical theory —or, as we now term it, the dynamical theory, as applied to heat—impressed itself upon the philosophers of the seventeenth century. Bacon defines heat as "a motion acting in its strife upon the smaller particles of bodies." Boyle saw clearly that when heat is generated by mechanical means new heat is called into existence, and believed that the production of heat and electricity were somehow correlated. Locke, in his "Essay on the Human Understanding," says that "what in our sensation is heat, in the object is nothing but motion." Hooke plainly perceived heat as a vibration, and denies the existence of anything without motion, and hence perfectly cold. Yet it was the material and not the mechanical theory which prevailed and which held the beliefs of the world up to our own time.—PARK BENJAMIN *Intellectual Rise in Electricity*, ch. 13, p. 416. (J. W., 1898.)

1452. ——— ——— *The Atomic Theory in Chemistry.*—As long as distance separates [atoms or molecules] they can move across it in obedience to the attraction; and the motion thus produced may, by proper appliances, be caused to perform mechanical work. When, for example, two atoms of hydrogen unite with one of oxygen, to form water, the atoms are first drawn towards each other—they move, they clash, and then, by virtue of their resiliency, they recoil and quiver. To this quivering motion we give the name of heat. This atomic vibration is merely the redistribution of the motion produced by the chemical affinity; and this is the only sense in which chemical affinity can be said to be converted into heat. We must not imagine the chemical attraction destroyed or converted into anything else. For the atoms, when mutually clasped to form a molecule of water, are held together by the very attraction which first drew them towards each other. That which has really been expended is the pull exerted through the space by which the distance between the atoms has been diminished.—TYNDALL *Fragments of Science*, vol. i, ch. 1, p. 25. (A., 1897.)

1453. HEAT AND ELECTRICITY—*Electric Conduction Increased by Cold—Atomic Theory of Electricity.*—If we make a comparison of electric conductors we find that the metals that conduct heat best also conduct electricity best. This, it seems to me, is a confirmation of the atomic theory of electricity so far as it means anything. If a good conductor, as silver, is subjected to intense cold by putting it into liquid air, its conductivity is greatly increased. It is well known that heating a conductor ordinarily diminishes its power to conduct electricity. This shows that, in order that electrical motion of the atom may have free play, the heat motion must be suppressed.—ELISHA GRAY *Nature's Miracles*, vol. iii, ch. 5, p. 47. (F. H. & H., 1900.)

1454. HEAT A RESULT OF MOTION—*Water of Cataract Warmed by the Fall—Ocean Made Warmer by Storm.*—This small basin contains a quantity of mercury which has been cooled in the next room. One of the faces of the thermo-electric pile is plunged into the liquid metal. The deflection of the needle proves that the mercury is cold. Two glasses are swathed thickly round with listing, to prevent the warmth of the hands from reaching the mercury. I pour the cold mercury into one of the glasses, and then from the one glass into the other, and back Its motion is destroyed, but heat is developed. The amount of heat generated by a single pouring out is extremely small: so we will repeat the process ten or fifteen times. The pile being now plunged into the liquid, the needle moves; and its motion declares that the mercury, which at the beginning of the experiment was cooler, is now warmer than the pile. We here introduce into the lecture-room an effect which occurs at the base of every waterfall. There are friends before me who have stood amid the foam of Niagara, and I have done so myself. Had we dipped sufficiently sensitive thermometers into the water at the top and at the bottom of the cataract, we should have found the latter warmer than the former. The sailor's tradition, also, is theoretically correct; the sea is rendered warmer by a storm, the mechanical dash of its billows being ultimately converted into heat.—TYNDALL *Heat a Mode of Motion*, lect. 1, p. 6. (A., 1900.)

1455. HEAT DEVELOPED BY CHEMISTRY AND ELECTRICITY—It has already been stated that chemical changes develop electricity; which, in its turn, becomes a powerful disturbing cause. As a chemical agent, says Davy, its silent and slow operation in the economy of Nature is much more important than its grand and impressive operation in lightning and thunder. It may be considered not only as directly producing an infinite variety of changes, but as influencing almost all which take place; it would seem, indeed, that chemical attraction itself is only a peculiar form of the exhibition of electrical attraction.—LYELL *Principles of Geology*, bk. ii, ch. 31, p. 542. (A., 1854.)

1456. HEAT, FRICTION AN INEXHAUSTIBLE SOURCE OF—*Count Rumford's Argument.*—With Rumford, however, a new and powerful factor appeared on the scene. He began by proving the hypothetical matter of heat to be imponderable, but the main drift of his experiments was to prove friction to be an inexhaustible source of heat, while the whole force of his logic went to show that an inexhaustible emission is irreconcilable with the notion that heat is a kind of matter.—TYNDALL *Heat a Mode of Motion*, lect. 2, p. 39. (A., 1900.)

1457. HEAT OF EARTH, LOSS OF—*No Sensible Diminution in Two Thousand Years.*—The gradual diminution of the supposed primitive heat of the globe has been resorted to by many geologists as the principal cause of alterations of climate. The matter of our planet is imagined, in accordance with the conjectures of Leibnitz, to have been originally in an intensely heated state, and to have been parting ever since with portions of its heat, and at the same time contracting its dimensions. There are, undoubtedly, good grounds for inferring from recent observation and experiment that the temperature of the earth increases as we descend from the surface to that slight depth to which man can penetrate: but there are no positive proofs of a secular decrease of internal heat accompanied by contraction. On the contrary, Laplace has shown, by reference to astronomical observations made in the time of Hipparchus, that in the last two thousand years at least there has been no sensible contraction of the globe by cooling; for had this been the case, even to an extremely small amount, the day

would have been shortened, whereas its length has certainly not diminished during that period by $\frac{1}{100}$th of a second.—LYELL *Principles of Geology*, bk. i, ch. 8, p. 129. (A., 1854.)

1458. HEAT OF HUMAN BODY—*Energy Expended in Maintaining—Other Expenditures of Energy.*—The amount of energy daily manifested by the adult human body in (a) the maintenance of its temperature; (b) in internal mechanical work, as in the movements of the respiratory muscles, the heart, etc.; and (c) in external mechanical work, as in locomotion and all other voluntary movements, has been reckoned at about 3,400 foot-tons. Of this amount only one-tenth is directly expended in internal and external mechanical work, the remainder being employed in the maintenance of the body's heat. The latter amount represents the heat which would be required to raise 48.4 lbs. of water from the freezing- to the boiling-point; or, if converted into mechanical power, it would suffice to raise the body of a man weighing about 150 lbs. through a vertical height of 8½ miles.

To the foregoing amounts of expenditure must be added the quite unknown quantity expended in the various manifestations of nerve-force, and in the work of nutrition and growth (using these terms in their widest sense). By comparing the amount of energy which should be produced in the body, from so much food of a given kind, with that which is actually manifested (as shown by the various products of combustion in the excretions), attempts have been made, indeed, to estimate, by a process of exclusion, these unknown quantities; but all such calculations must be at present considered only very doubtfully approximate.—BAKER *Handbook of Physiology*, vol. ii, ch. 17, p. 65. (W. W., 1885.)

1459. ——— *Loss of, in Exercise—Exertion Creates New Supply.*—It would appear . . . that the body ought to grow colder, in the act of climbing or of working [since heat is thrown off from the body into space], whereas universal experience proves it to grow warmer. The solution of this seeming contradiction is found in the fact that, when the muscles are exerted, augmented respiration and increased chemical action set in. The fan which urges oxygen into the fire within is more briskly moved; and thus, tho heat actually disappears as we climb, the loss is more than covered by the increased activity of the chemical processes.—TYNDALL *Heat a Mode of Motion*, lect. 17, p. 531. (A., 1900.)

1460. ——— *Loss of, through Inanition—Death by Starvation Is Death by Cold—External Warmth in Exhaustive Diseases.*—It has been often said, and with truth, altho the statement requires some qualification, that death by starvation is really death by cold: for not only has it been found that differences of time with regard to the period of the fatal result are attended by the same ultimate loss of heat [about 30° F.], but the . . . application of external warmth to animals cold and dying from starvation is [found to be] more effectual in reviving them than the administration of food. In other words, an animal exhausted by deprivation of nourishment is unable so to digest food as to use it as fuel, and therefore is dependent for heat on its supply from without. Similar facts are often observed in the treatment of exhaustive diseases in man.—BAKER *Handbook of Physiology*, vol. i, ch. 7, p. 220. (W. W., 1885.)

1461. HEAT OF THE ATMOSPHERE—*Chill of Upper Air—Absolute Zero of Space.*—If we suddenly compress a cubic foot of air at ordinary pressure into a cubic inch of space, that cubic inch will be very hot because it contains all the heat that was distributed through the entire cubic foot before the compression took place. Now let it remain compressed until the heat has radiated from it, as it soon will, and the air becomes of the same temperature as the surrounding air. What ought to happen if then we should suddenly allow this cubic inch of air to expand to its normal pressure, when it will occupy a cubic foot of space? Inasmuch as we allowed the heat to escape from it when in the condensed form, when it expands it will be very cold, because the heat of the cubic inch, now reduced to the normal temperature of the surrounding air, is distributed over a cubic foot of space. This is precisely what takes place when heated air at the surface of the earth (which is condensed to a certain extent) rises to the higher regions of the atmosphere. There is a gradual expansion as it ascends, and consequently a gradual cooling, because a given amount of heat is being constantly distributed over a greater amount of space. At an altitude of forty-five miles it will have expanded about 25,000 times, which will bring the temperature down to between 200 and 300 degrees below zero. When we get beyond the limits of the atmosphere we get into the region of absolute cold, because heat is atomic motion, and there can be no atomic motion where there are no atoms.—ELISHA GRAY *Nature's Miracles*, vol. i, ch. 7, p. 54. (F. H. & H., 1900.)

1462. HEAT, PLANTS NEED UNIFORM—*Light May Vary More.*—There is every reason to conclude that the range of intensity of light to which living plants can accommodate themselves is far wider than that of heat. No palms or tree-ferns can live in our temperate latitudes without protection from the cold: but when placed in hothouses they grow luxuriantly, even under a cloudy sky, and where much light is intercepted by the glass and frame-work. At St. Petersburg, in lat. 60° N., these plants have been successfully cultivated in

hothouses, altho there they must exchange the perpetual equinox of their native regions for days and nights which are alternately protracted to nineteen hours and shortened to five. How much farther towards the pole they might continue to live, provided a due quantity of heat and moisture were supplied, has not yet been determined; but St. Petersburg is probably not the utmost limit, and we should expect that in lat. 65° at least, where they would never remain twenty-four hours without enjoying the sun's light, they might still exist.—LYELL *Principles of Geology*, bk. i, ch. 6, p. 89. (A., 1854.)

1463. HEAT PRODUCING COLD—*Refrigeration Improves Food of Nations.*—Since heat is transformable into motive power, and motive power can force ammonia to chill itself, a ton of coal, according to quality, can make six to ten tons of ice in competition with the frosts of winter. Because their product is pure, refrigerating-machines are finding more and more favor in cities once supplied exclusively with ice from ponds and streams. . . . Cold, so singular an issue of heat, has high commercial value. Apples and grapes harvested in September and October are sent from the cold-storage warehouse to the table in perfect order as late as May. The fruit-grower and the dairyman have a new opportunity to choose the time for marketing their products. Refrigerator steamships now carry Canadian butter and New Zealand meat in vast quantities to the markets of Great Britain. Within the shorter distances traversed by the railroads of the United States the strawberries of Oregon find their way unbruised and fresh to St. Paul and Chicago, while the kitchen-gardeners of Florida and Louisiana look for their customers in New England and New York. There is more in all this than the mere purveying of luxuries; there is an increase of individual health and strength when a national bill of fare is at once diversified and made more wholesome. Whereas heat in the hands of early man served to multiply his foods by primitive methods of roasting, of smoking, of preservation in grease—as pemmican—the later applications of heat by the modern engineer are of incomparable service in multiplying the food-resources of the civilized world. Cold storage and quick transportation supplement in remarkable fashion every device that has sprung from the aboriginal grill and kettle.—ILES *Flame, Electricity, and the Camera*, ch. 5, p. 66. (D. & McC., 1900.)

1464. HEAT PROVED NOT A SUBSTANCE—*Thermal Vibration Compared to Sound of Bell.*—With regard to the illustration which compared heat to water contained in a sponge, Rumford replied thus: "A sponge filled with water and hung by a thread in the middle of a room filled with dry air communicates its moisture to the air, it is true, but soon the water evaporates and the sponge can no longer give out moisture." The case, he contended, is not at all similar to heat; for here, by renewed mechanical action, we can cause the heat to flow out at will. "A bell," he says, "sounds without intermission when it is struck, and gives out its sound as often as we please, without any perceptible loss. Moisture is a substance, sound is not." Heat, he contended, was typified by the vibrating bell and not by the evaporating sponge.—TYNDALL *Heat a Mode of Motion*, lect. 2, p. 46. (A., 1900.)

1465. HEAT, SUPPLY OF, WITHIN THE EARTH—*Science May Yet Mine for Heat—A City Receives Hot Water from Underground.*—So marked is this steady increase of temperature as we go downwards, that it has been seriously proposed to make very deep borings in order to obtain supplies of warm water for heating our towns. Arago and Walferdin suggested this method for warming the Jardin des Plantes at Paris; and now that such important improvements have been devised in carrying borings to enormous depths, the time may not be far distant when we shall draw extensively upon these supplies of subterranean heat. At the present time the city of Budapest is extensively supplied with hot water from an underground source. Should our coal-supply ever fail, it may be well to remember that we have these inexhaustible supplies of heat everywhere beneath our feet.—JUDD *Volcanoes*, ch. 12, p. 335. (A., 1899.)

1466. HEAT SUPPOSED TO BE MATTER—*Phlogiston—Count Rumford's Experiment—Heat Proved To Be Motion—Errors of Early Scientists.*—Down to the beginning of this century heat was generally considered to be a form of matter, termed caloric or phlogiston. The presence of phlogiston was supposed to render substances combustible, but when the chemical theory of combustion was discovered by Lavoisier, phlogiston, as the cause of combustion, disappeared, altho caloric, as the material basis of heat, still held its ground. Close to the end of the last century Count Rumford showed that in boring a brass cannon the heat developed in 2½ hours was sufficient to raise 26½ lbs. of water from the freezing- to the boiling-point. But during the operation the metal had lost no weight nor undergone any other change; and as the production of heat by this process appeared to be unlimited he concluded that heat could not be matter, but merely a kind of motion set up in the particles of matter by the force exerted. . . . Such facts led to the conclusion that there was a mechanical equivalent of heat—that is, that a certain amount of force exerted or work done would produce a corresponding amount of heat; and Joule was the first to determine this accurately by a number of ingenious experiments. The result was found to be that a pound of water can be raised 1° C. by an amount of work equal

to that required to raise one pound to the height of 1,392 feet, or 1,392 lbs. one foot. Various experiments with different materials were found always to lead to the same result, and thus the final blow was given to the material theory of heat, which was thenceforth held to be a mode of motion of the molecules of bodies.—WALLACE *The Wonderful Century*, ch. 7, p. 51. (D. M. & Co., 1899.)

1467. HEAT TRANSFORMED INTO FORCE, AND FORCE AGAIN INTO HEAT—The doctrine of heat as due to vibration explains how heat is transformed force, so that the steam-hammer worked by the heat used in the furnace can be set to beat cold iron till it is white-hot; thus part of the force which came from heat has gone back into heat, and with the heat reappears the other form of radiant energy, light.—TYLOR *Anthropology*, ch. 13, p. 327. (A., 1899.)

1468. HEAT TRANSFORMED INTO MOTION, AND VICE VERSA—We derive the muscle and fat of our bodies from what we eat. Animal heat you know to be due to the slow combustion of this fuel. My arm is now inactive, and the ordinary slow combustion of my blood and tissue is going on. For every grain of fuel thus burnt a perfectly definite amount of heat has been produced. I now contract my biceps muscle without causing it to perform external work. The combustion is quickened and the heat is increased, this additional heat being liberated in the muscle itself. I lay hold of a 56-lb. weight, and by the contraction of my biceps lift it through the vertical space of a foot. The blood and tissue consumed during this contraction have not developed in the muscle their due amount of heat. A quantity of heat is at this moment missing in the muscle which would raise the temperature of an ounce of water somewhat more than 1° F. I liberate the weight; it falls to the earth, and by its collision generates the missing heat. Muscular heat is thus transferred from its local hearth to external space. The fuel is consumed in the body, but the heat of combustion is produced outside the body. The case is substantially the same as that of the voltaic battery when it performs external work or produces external heat.—TYNDALL *Heat a Mode of Motion*, lect. 3, p. 83. (A., 1900.)

1469. HEIGHTS ATTAINED BY INSECTS—*Butterflies on Mont Blanc—Flies on Chimborazo.*—Saussure found butterflies on Mont Blanc, and Ramond observed them in the solitudes around the summit of Mont Perdu. When MM. Bonpland, Carlos Montufar, and myself, on the 23d of June, 1802, ascended the eastern declivity of Mount Chimborazo, to a height of 19,286 feet, and where the barometer had fallen to 14.84 inches, we found winged insects buzzing around us. We recognized them to be *Diptera*, resembling flies, but it was impossible to catch these insects standing on the rocky ledges *(cuchilla)*, often less than a foot in breadth, and between masses of snow precipitated from above. The elevation at which we observed these insects was almost the same as that in which the naked trachytic rock, which projected from the eternal snows around, exhibited the last traces of vegetation in *Lecidea geographica.* These insects were flying at an elevation of 18,225 feet, or nearly 2,660 feet higher than the summit of Mont Blanc; and somewhat below this height, at an elevation of 16,626 feet, and therefore also above the region of snow, M. Bonpland saw yellow butterflies flying close to the ground.—HUMBOLDT *Views of Nature*, p. 232. (Bell, 1896.)

1470. HELP TO THE NEEDY—*Good Samaritan in the Ant World.*—One day, watching a small column of these ants *(i. e., Eciton hamata)*, I placed a little stone on one of them to secure it. The next that approached, as soon as it discovered its situation, ran backwards in an agitated manner, and soon communicated the intelligence to the others. They rushed to the rescue; some bit at the stone and tried to move it, others seized the prisoner by the legs and tugged with such force that I thought the legs would be pulled off, but they persevered until they got the captive free. I next covered one up with a piece of clay, leaving only the ends of its antennæ projecting. It was soon discovered by its fellows, which set to work immediately, and by biting off pieces of the clay soon liberated it. Another time I found a very few of them passing along at intervals. I confined one of these under a piece of clay at a little distance from the line, with his head projecting. Several ants passed it, but at last one discovered it and tried to pull it out, but could not. It immediately set off at a great rate, and I thought it had deserted its comrade, but it had only gone for assistance, for in a short time about a dozen ants came hurrying up, evidently fully informed of the circumstances of the case, for they made directly for their imprisoned comrade and soon set him free. I do not see how this action could be instinctive. It was sympathetic help, such as man only among the higher mammalia shows. The excitement and ardor with which they carried on their unflagging exertions for the rescue of their comrade could not have been greater if they had been human beings.—ROMANES *Animal Intelligence*, ch. 3, p. 47. (A., 1899.)

1471. HELPLESS DESTROYED BY STRONG—*The Herd Gores the Disabled Cow to Death.*—It remains now to speak of that seemingly most cruel of instincts [that leads a herd to kill the injured]. It is very common among gregarious animals that are at all combative in disposition, and still survives in our domestic cattle, altho very rarely witnessed in England. My first experience of it was just before I had reached the

age of five years. I was not at that early period trying to find out any of Nature's secrets. but the scene I witnessed printed itself vividly on my mind, so that I can recall it as well as if my years had been five-and-twenty; perhaps better. It was on a summer's evening, and I was out by myself at some distance from the house, playing about the high exposed roots of some old trees; on the other side of the trees the cattle, just returned from pasture, were gathered on the bare level ground. Hearing a great commotion among them, I climbed on to one of the high exposed roots, and looking over saw a cow on the ground, apparently unable to rise, moaning and bellowing in a distressed way, while a number of her companions were crowding round and goring her. [Interpreted by Romanes and others as a protection of the herd against being followed by beasts of prey; by Hudson as a frenzy of instinct misdirected.]—HUDSON *Naturalist in La Plata*, ch. 22, p. 339. (C. & H., 1895.)

1472. HELPLESSNESS A SOURCE OF POWER—*Prolongation of Infancy Accompanied by Increase of Brain-surface—Gulf between Man and Ape.*—The gulf by which the lowest known man is separated from the highest known ape consists in the great increase of his cerebral surface, with the accompanying intelligence, and in the very long duration of his infancy. These two things have gone hand in hand. The increase of cerebral surface, due to the working of natural selection in this direction alone, has entailed a vast increase in the amount of cerebral organization that must be left to be completed after birth, and thus has prolonged the period of infancy. And, conversely, the prolonging of the plastic period of infancy, entailing a vast increase in teachableness and versatility, has contributed to the further enlargement of the cerebral surface.—FISKE *Destiny of Man*, ch. 6, p. 54. (H. M. & Co., 1900.)

1473. HELPLESSNESS OF HUMAN BABE—*Contrast with Baby Monkey—Bodily Development Retarded by the Demands of the Finer Brain—This Trains Motherhood.*—In a few days or weeks the baby monkey is almost able to leave its mother. Already it can climb and eat and chatter like its parents, and in a few weeks more the creature is as independent of them as the winged seed is of the parent tree. Meantime, and for many months to come, its little twin is unable to feed itself, or clothe itself, or protect itself; it is a mere semi-unconscious chattel, a sprawling ball of helplessness, the world's one type of impotence. The body is there in all its parts, bone for bone and muscle for muscle, like the other. But somehow this body will not do its work. Something as yet hangs fire. The body has eyes, but they see not; ears, but they hear not; limbs, but they walk not. This body is a failure. Why does the human infant lie like a log on the forest-bed while its nimble prototype mocks it from the bough above? . . . It was necessary for moral training that the human child should have the longest possible time by its mother's side—but what determines it on the physical side? The thing that constitutes the difference between the baby monkey and the baby man is an extra piece of machinery which the last possesses and the first does not. It is this which is keeping back the baby man. What is that piece of machinery? A brain, a human brain. The child, nevertheless, is not using it. Why? Because it is not quite fitted up. Nature is working hard at it; but owing to its intricacy and delicacy the process requires much time, and till all is ready the babe must remain a thing. And why does the monkey brain get ready first? Because it is an easier machine to make. And why should it be easier to make? Because it is only required to do the life-work of an animal; the other has to do the life-work of a man.—DRUMMOND *Ascent of Man*, ch. 8, p. 282. (J. P., 1900.)

1474. ——— ——— *Prolonged Infancy Gives Time to Elaborate the Brain—Childhood a Time of Installations and Trials.*—Now infancy, physiologically considered, means the fitting up of this extra machinery within the brain; and according to its elaborateness will be the time required to perfect it. A sailing-vessel may put to sea the moment the rigging is in; a steamer must wait for the engines. And the compensation to the steamer for the longer time in dock is discovered by and by in its vastly greater usefulness, its power of varying its course at will, and in its superior safety in time of war or storm. For its greater afterusefulness also, its more varied career, its safer life, humanity has to pay tribute to evolution by a delayed and helpless infancy, a prolonged and critical constructive process. Childhood in its early stage is a series of installations and trials of the new machinery, a slow experimenting with powers and faculties so fresh that heredity in handing them down has been unable to accompany them with full directions as to their use.—DRUMMOND *Ascent of Man*, ch. 8, p. 285. (J. P., 1900.)

1475. HELPLESSNESS RESULTING FROM INDOLENCE—*Slaveholding Ants Forget How To Feed Themselves.*—In consequence of being constantly fed by their slaves, the red ants have entirely forgotten how to procure food for themselves. If they are shut up and supplied with honey, which is their favorite food, they will not touch it, but will suffer hunger, become weak and feeble, and ultimately, die of starvation, unless pity is taken upon them and they are given one of their dusky slaves. Directly this is done the slave falls to work, eats a quantity of the honey, and then proceeds to feed its masters, which are per-

fectly willing to be saved from starvation in this manner.—WEISMANN *Heredity*, vol. ii, ch. 9, p. 26. (Cl. P., 1897.)

1476. HEMISPHERES OF BRAIN CONTROL OPPOSITE SIDE OF BODY—Electrical currents of small intensity applied to the surface of the said convolutions [of the brain] in dogs, monkeys, and other animals produce well-defined movements in face, fore-limb, hind-limb, tail, or trunk, according as one point or another of the surface is irritated. These movements affect almost invariably the side opposite to the brain irritations: If the left hemisphere be excited the movement is of the right leg, side of face, etc.—JAMES *Psychology*, vol. i, ch. 2, p. 31. (H. H. & Co., 1899.)

1477. HERCULANEUM BURIED IN LAVA—*Nearer than Pompeii to the Volcano—Cast of Buried Mask—Ancient Buildings Enclosed in Rock.*—It was remarked that no lava has flowed over the site of Pompeii since that city was built, but with Herculaneum the case is different. Altho the substance which fills the interior of the houses and the vaults must have been introduced in a state of mud, like that found in similar situations in Pompeii, yet the superincumbent mass differs wholly in composition and thickness. Herculaneum was situated several miles nearer to the volcano, and has, therefore, been always more exposed to be covered, not only by showers of ashes, but by alluviums and streams of lava. Accordingly, masses of both have accumulated on each other above the city to a depth of nowhere less than 70, and in many places of 112 feet.

The tuff which envelops the buildings consists of comminuted volcanic ashes, mixed with pumice. A mask embedded in this matrix has left a cast, the sharpness of which was compared by Hamilton to those in plaster of Paris; nor was the mask in the least degree scorched, as if it had been embedded in heated matter. This tuff is porous; and, when first excavated, is soft and easily worked, but acquires a considerable degree of induration on exposure to the air.—LYELL *Principles of Geology*, bk. ii, ch. 24, p. 389. (A., 1854.)

1478. HERCULANEUM, RELICS IN—*Remarkable Preservation of Ancient Objects—Perishable Goods Remaining of Owners Who Vanished Centuries Ago.*—The wooden beams in the houses at Herculaneum are black on the exterior, but, when cleft open, they appear to be almost in the state of ordinary wood, and the progress made by the whole mass towards the state of lignite is scarcely appreciable. Some animal and vegetable substances of more perishable kinds have, of course, suffered much change and decay, yet the state of preservation of these is truly remarkable. Fishing-nets are very abundant in both cities, often quite entire; and their number at Pompeii is the more interesting from the sea being now, as we stated, a mile distant. Linen has been found at Herculaneum, with the texture well defined; and in a fruiterer's shop in that city were discovered vessels full of almonds, chestnuts, walnuts, and fruit of the "carubiere," all distinctly recognizable from their shape. A loaf, also, still retaining its form, was found in a baker's shop, with his name stamped upon it. On the counter of an apothecary was a box of pills converted into a fine earthy substance, and by the side of it a small cylindrical roll evidently prepared to be cut into pills. By the side of these was a jar containing medicinal herbs. In 1827, moist olives were found in a square glass case, and "caviare," or roe of a fish, in a state of wonderful preservation. An examination of these curious condiments has been published by Covelli, of Naples, and they are preserved hermetically sealed in the museum there.—LYELL *Principles of Geology*, bk. ii, ch. 24, p. 392. (A., 1854.)

1479. HEREDITY, ALCOHOLIC—*Statistics of Idiocy and Insanity.*—There is one class of cases, moreover, in which a particular abnormal form of nutrition that is distinctly acquired by the individual exerts a most injurious influence upon the offspring—that, namely, which is the result of such habitual alcoholic excess as modifies the nutrition of the nervous system.

We have a far larger experience of the results of habitual alcoholic excess than we have in regard to any other "nervine stimulant": and all such experience is decidedly in favor of the hereditary transmission of that acquired perversion of the normal nutrition which it has engendered in the individual. That this manifests itself sometimes in congenital idiocy, sometimes in a predisposition to insanity, which requires but a very slight exciting cause to develop it, and sometimes in a strong craving for alcoholic drinks, which the unhappy subject of it strives in vain to resist, is the concurrent testimony of all who have directed their attention to the inquiry. Thus Dr. Howe, in his report on the statistics of idiocy in Massachusetts, states that the habits of the parents of 300 idiots having been learned, 145, or nearly one-half, were found to be habitual drunkards. In one instance, in which both parents were drunkards, seven idiotic children were born to them. Dr. Down, whose experience of idiocy is greater than that of any other man in this country, has assured the writer that he does not consider Dr. Howe's statement as at all exaggerated. Dr. W. A. F. Browne, the first Medical Lunacy Commissioner for Scotland, thus wrote when himself in charge of a large asylum: "The drunkard not only injures and enfeebles his own nervous system, but entails mental disease upon his family. His daughters are nervous and hysterical; his sons are weak, wayward, eccentric, and sink under the pressure of excitement of some unforeseen exigency, or the ordinary calls of duty." Dr. Howe remarks

that the children of drunkards are deficient in bodily and vital energy, and are predisposed by their very organization to have cravings for alcoholic stimulants. If they pursue the course of their fathers, which they have more temptation to follow, and less power to avoid, than the children of the temperate, they add to their hereditary weakness, and increase the tendency to idiocy or insanity in their constitution, and this they leave to their children after them. [See ALCOHOL.]—CARPENTER *Mental Physiology*, ch. 8, p. 370. (A., 1900.)

1480. HEREDITY AND ENVIRONMENT —*Master-influences of Life.*—These two, heredity and environment, are the master-influences of the organic world. These have made all of us what we are. These forces are still ceaselessly playing upon all our lives. And he who truly understands these influences; he who has decided how much to allow to each; he who can regulate new forces as they arise, or adjust them to the old, so directing them as at one moment to make them cooperate, at another to counteract one another, understands the rationale of personal development. To seize continuously the opportunity of more and more perfect adjustment to better and higher conditions, to balance some inward evil with some purer influence acting from without, in a word to make our environment at the same time that it is making us—these are the secrets of a well-ordered and successful life. —DRUMMOND *Natural Law in the Spiritual World*, essay 7, p. 229. (H. M.)

1481. HEREDITY EVERYTHING IN LOWEST TYPE OF ANIMAL—*Starts with Nothing To Learn.*—The psychical life of the lowest animals consists of a few simple acts directed toward the securing of food and the avoidance of danger, and these acts we are in the habit of classing as instinctive. They are so simple, so few, and so often repeated that the tendency to perform them is completely organized in the nervous system before birth. The animal takes care of himself as soon as he begins to live. He has nothing to learn, and his career is a simple repetition of the careers of countless ancestors. With him heredity is everything, and his individual experience is next to nothing.—FISKE *Destiny of Man*, ch. 4, p. 39. (H. M. & Co., 1900.)

1482. HEREDITY IN ASTRONOMIC RESEARCH—*The Younger Carries on the Researches of the Elder Herschel.*—In his special line as a celestial explorer of the most comprehensive type, Sir William Herschel had but one legitimate successor, and that successor was his son. John Frederick William Herschel was born at Slough, March 17, 1792, graduated with the highest honors from St. John's College, Cambridge, in 1813, and entered upon legal studies with a view to being called to the bar. But his share in an early compact with Peacock and Babbage, "to do their best to leave the world wiser than they found it," was not thus to be fulfilled. The acquaintance of Dr. Wollaston decided his scientific vocation. . . .

The full results of [Sir John] Herschel's journey to the Cape were not made public until 1847, when a splendid volume embodying them was brought out at the expense of the Duke of Northumberland. They form a sequel to his father's labors such as the investigations of one man have rarely received from those of another. What the elder observer did for the northern heavens, the younger did for the southern.—CLERKE *History of Astronomy*, pt. i, ch. 2, pp. 54, 56. (Bl., 1893.)

1483. HEREDITY MAY TRANSMIT PREDISPOSITION TO DISEASE—*Environment a Predisposing Cause.*—We know from experience that a full measure of health is not often the happy condition of human tissues; we have, in short, a variety of circumstances which, as we say, predispose the individual to disease. One of the commonest forms of predisposition is that due to heredity. Probably it is true that what are known as hereditary diseases are due far more to a hereditary predisposition than to any transmission of the virus itself in any form. Antecedent disease predisposes the tissues to form a nidus for bacteria; conditions of environment or personal habits frequently act in the same way. Damp soils must be held responsible for many disasters to health, not directly, but indirectly, by predisposition; dusty trades and injurious occupations have a similar effect. Any one of these three different influences may in a variety of ways affect the tissues and increase their susceptibility to disease. Not infrequently we may get them combined.—NEWMAN *Bacteria*, ch. 8, p. 268. (G. P. P., 1899.)

1484. HEREDITY OF ACQUIRED CHARACTERS -*Cope's Advocacy of the Doctrine.*—Cope early adopted the doctrine of transmutation of species, and recognized the truth that all the animals of the present epoch are descendants from those of past times, with modifications which separate them as species, and eventually as representatives of genera, of families and orders differing from the earlier ones as we retrace the steps of time farther and farther back. He was not, however, satisfied with Darwin's theory, and denied that natural selection was a sufficient factor for differentiation. He would not admit that animals were passive subjects and that the slight variations which were manifest in the progeny of species were sufficient to enable Nature to select from and to fit for future conditions. He contended that the volition and endeavors of an animal had much to do with future progeny as well as its own brief life. In short, he claimed that characters acquired by animals through their own efforts, or forced on them by vari-

ous external agencies or accidents, might be transmitted to their offspring. [See DEVIATIONS INHERITABLE.] — GILL *Address in Memory of Edward Drinker Cope* in *Proceedings of Amer. Assoc. for Advancement of Science*, vol. xlvi, 1897.

1485. ——— ——— *Epileptic Guinea-pigs.*—A very curious example of the transmission of tendencies to special automatic movements, the secondary acquirement of which tendencies is altogether beyond doubt, is afforded by the following curious fact established by the researches of M. Brown-Séquard: In the course of his masterly experimental investigations on the functions of the nervous system, he discovered that, after a particular lesion of the spinal cord of guinea-pigs, a slight pinching of the skin of the face would throw the animals into a kind of epileptic convulsion. That this artificial epilepsy should be constantly producible in guinea-pigs, and not in any other animals experimented upon, was in itself sufficiently singular; and it was not less surprising that the tendency to it persisted, after the lesion of the spinal cord seemed to have been entirely recovered from. But it was far more wonderful that when these epileptic guinea-pigs bred together, their offspring showed the same predisposition, without having been themselves subjected to any lesion whatever; whilst no such tendency showed itself in any of the large number of young, which were bred by the same accurate observer from parents that had not thus been operated on.—CARPENTER *Mental Physiology*, ch. 8, p. 371. (A., 1900.)

1486. ——— ——— *How Limited.*—In [many] exercises of [animal] intelligence we may trace the manifestations of a hereditary transmission of aptitudes for particular kinds of mental action which have been originally acquired by habit. Dogs of other breeds cannot be taught to herd sheep in the manner which "comes naturally" to the young of the shepherd's dog. And it is well known that young pointers and retrievers, when first taken into the field, will often "work" as well as if they had been long trained to the requirements of the sportsman. The curious fact was observed by Mr. Knight that the young of a breed of springing spaniels which had been trained for several successive generations to find woodcocks, seemed to know as well as the old dogs what degree of frost would drive the birds to seek their food in unfrozen springs and rills. Among the descendants of the dogs originally introduced into South America by the Spaniards there are breeds which have learned by their own experience, without any human training, the best modes of attacking the wild animals they pursue; and since young dogs have been observed to practise these methods the very first time they engage in the chase, with as much address as old dogs, it can scarcely be questioned that the tendency to the performance of them has been embodied in the organization of the race, and is thus transmitted hereditarily. There seems reason to believe that such hereditary transmission is limited to acquired peculiarities which are simply modifications of the natural constitution of the race, and would not extend to such as may be altogether foreign to it. But the foregoing facts would seem to justify the belief that the like hereditary transmission of acquired aptitudes may take place in man; and that, in accordance with the far wider range of his faculties, it may become the means of a far higher exaltation of them.—CARPENTER *Mental Physiology*, ch. 2, p. 102. (A., 1900.)

1487. ——— ——— *Inherited Effect of Changed Habits.*—Changed habits produce an inherited effect, as in the period of the flowering of plants when transported from one climate to another. With animals the increased use or disuse of parts has had a more marked influence; thus I find in the domestic duck that the bones of the wing weigh less and the bones of the leg more, in proportion to the whole skeleton, than do the same bones in the wild duck; and this change may be safely attributed to the domestic duck flying much less, and walking more, than its wild parents. [See INHERITANCE.]—DARWIN *Origin of Species*, ch. 1, p. 10. (Burt.)

1488. ——— ——— *Mental Habitudes Transmitted as Tendencies.*—Now, as there can be no doubt of the hereditary transmission in man of acquired constitutional peculiarities, which manifest themselves alike in tendencies to bodily and to mental disease, so it seems equally certain that acquired mental habitudes often impress themselves on his organization with sufficient force and permanence to occasion their transmission to the offspring as tendencies to similar modes of thought. And thus, while all admit that knowledge cannot thus descend from one generation to another, an increased aptitude for the acquirement, either of knowledge generally, or of some particular kind of it, may be thus inherited. These tendencies and aptitudes will acquire additional strength, expansion, and permanence in each new generation, from their habitual exercise upon the materials supplied by a continually enlarged experience; and thus the acquired habitudes produced by the intellectual culture of ages will become a "second nature" to every one who inherits them.—CARPENTER *Nature and Man*, lect. 6, p. 197. (A., 1889.)

1489. ——— ——— *New Instincts the Result of Changed Circumstances.*—This explanation of the origin of the migratory instinct, and the reason why birds take certain determinate routes over the sea, is in perfect agreement with the conclusion at which Mr. Darwin arrived at an even earlier date, tho the facts were not pub-

lished until after his death. Instincts, he shows, can be acquired. Birds which were once perfectly fearless of man now display the usual terror, since the oceanic islands which they inhabit have been visited or settled, and transmit their prudent instinct to their offspring. On the other hand, while at first frightened by passing railway trains, they soon learn that these novelties betoken no danger, and so in time the birds alongside the lines view them with the most perfect equanimity. The sheep, which in Spain are taken every summer to pastures in another part of the country, acquire by and by an instinct for this artificial migration, which is displayed by curious uneasy motions, so strong that about the time when they ought to be off it requires all the vigilance of the shepherds to prevent them escaping, and there are cases in which the journey has been performed, the animals reaching their old feeding-grounds without assistance.—BROWN *Nature-Studies*, p. 21. (Hum., 1888.)

1490. ——— ——— *The Question Stated — Government and Philanthropy Involved.*—It is obvious that we can produce important changes in the individual. We can, for example, improve his muscles by athletics and his brain by education. The use of organs enlarges and strengthens them; the disuse of parts or faculties weakens them. And so great is the power of habit that it is proverbially spoken of as "second nature." It is thus certain that we can modify the individual. We can strengthen (or weaken) his body: we can improve (or deteriorate) his intellect, his habits, his morals. But there remains the still more important question which we are about to consider. Will such modifications be inherited by the offspring of the modified individual? Does individual improvement transmit itself to descendants independently of personal teaching and example? Have artificially produced changes of structure or habit any inherent tendency to become congenitally transmissible and to be converted in time into fixed traits of constitution or character? Can the philanthropist rely on such a tendency as a hopeful factor in the evolution of mankind? the only sound and stable basis of a higher and happier state of things being, as he knows or ought to know, the innate and constitutionally fixed improvement of the race as a whole. If acquired modifications are impressed on the offspring and on the race, the systematic moral training of individuals will in time produce a constitutionally moral race. . . . But if acquired modifications do not tend to be transmitted, if the use or disuse of organs or faculties does not similarly affect posterity by inheritance, then it is evident that no innate improvement in the race can take place without the aid of natural or artificial selection.—BALL *Are the Effects of Use and Disuse Inherited?* p. 7 (Hum., 1891.)

1491. ——— ——— *Views of Spencer and Mill—Brain-states Transmissible.*—This doctrine [of heredity of acquired characters] was first explicitly put forth by Mr. Herbert Spencer, in whose philosophical treatises it will be found most ably developed. I am glad to be able to append the following extract from a letter which Mr. John Mill, the great master of the experiential school, was good enough to write to me a few months since, with reference to the attempt I had made to place "common sense" upon this basis (*Contemporary Review*, February, 1872): "When states of mind in no respect innate or instinctive have been frequently repeated, the mind acquires, as is proved by the power of habit, a greatly increased facility of passing into those states; and this increased facility must be owing to some change of a physical character in the organic action of the brain. There is also considerable evidence that such acquired facilities of passing into certain modes of cerebral action can, in many cases, be transmitted, more or less completely, by inheritance. The limits of this power of transmission, and the conditions on which it depends, are a subject now fairly before the scientific world, and we shall doubtless in time know much more about them than we do now. But so far as my imperfect knowledge of the subject qualifies me to have an opinion, I take much the same view of it that you do, at least in principle."—CARPENTER *Nature and Man*, lect. 6, p. 197. (A., 1889.)

1492. HEREDITY OF AN IDIOT—*Four Steps from Immorality to Imbecility—Alcoholic Excess from the Outset.*—Morel has traced through four generations the family history of a youth who was admitted into the asylum at Rouen in a state of stupidity and semi-idiocy; the summary of which may fitly illustrate the natural course of degeneracy when it goes on through generations.

First generation: Immorality, depravity, alcoholic excess, and moral degradation, in the great-grandfather, who was killed in a tavern brawl.

Second generation: Hereditary drunkenness, maniacal attacks, ending in general paralysis, in the grandfather.

Third generation: Sobriety, but hypochondriacal tendencies, delusions of persecutions, and homicidal tendencies in the father.

Fourth generation: Defective intelligence. First attack of mania at sixteen; stupidity and transition to complete idiocy.—MAUDSLEY *Body and Mind*, lect. 2, p. 45. (A., 1898.)

1493. HEREDITY MOLDS CHARACTER—*Improvement and Adaptation.*—The setting-dog is taught to set; he squats down and points at the game; but the habit is an acquired one—a mere trick of education. What, however, is merely acquired habit in the progenitor is found to pass into instinct

n the descendant; the puppy of the setting-dog squats down and sets untaught—the educational trick of the parent is mysteriously transmuted into an original principle in the offspring. The adaptation which takes place in the forms and constitution of plants and animals when placed in circumstances different from their ordinary ones is equally striking. The woody plant of a warmer climate when transplanted into a colder frequently exchanges its ligneous stem for a herbaceous one, as if in anticipation of the killing frosts of winter; and, dying to the ground at the close of autumn, shoots up again in spring. The dog, transported from a temperate into a frigid region, exchanges his covering of hair for a covering of wool; when brought back again to his former habitat the wool is displaced by the original hair. And hence, and from similar instances, the derivation of an argument, good so far as it goes, for changes in adaptation to altered circumstances of the organization of plants and animals, and for the improvability of instinct.—MILLER *The Old Red Sandstone*, ch. 3, p. 36. (G. & L., 1851.)

1494. HEREDITY, UNIVERSAL RECOGNITION OF—The transmission of characteristics of species and race is admitted by everybody who deals with the body or the soul. Nobody fears to admit within these limits the fatality of birth. It is thus that every historian refers to the national character in explaining the events in the lives of a people, recognizing its persistence, and pronouncing the consequences often inevitable. The French of this day recognize themselves in the portrait of the Gauls as drawn by Julius Cæsar. The modern Greeks are in many respects the same as those whom Demosthenes addressed. If you take a young savage whose parents were hunters, vain will be your efforts to cultivate him and adapt him to the habits of civilized life. The voice of his ancestor speaks to him, incessantly recalling him to the instinct and adventures of forest life.

Heredity is the result of a very general law, by virtue of which all the anatomical elements of the body possess the property of giving direct birth to similar elements, or of determining in their own vicinity a generation of elements of the same kind (Littré et Robin). The phenomena of nutrition depend upon this same law, by virtue of which the human body, incessantly renewed, remains always identical with itself from the redistribution of atomic elements.—LORIN *General View of the Laws of Heredity (Thesis for the Degree in Medicine, 1875)*.

1495. HEROISM AND ASCETICISM IN DAILY LIFE—*Preparation for Unforeseen Emergency.*—It is not simply particular lines of discharge, but also general forms of discharge, that seem to be grooved out by habit in the brain. Just as, if we let our emotions evaporate, they get into a way of evaporating, so there is reason to suppose that if we often flinch from making an effort, before we know it the effort-making capacity will be gone, and that if we suffer the wandering of our attention, presently it will wander all the time. . . . As a final practical maxim relative to these habits of the will, we may, then, offer something like this: Keep the faculty of effort alive in you by a little gratuitous exercise every day. That is, be systematically ascetic or heroic in little unnecessary points, do every day or two something for no other reason than that you would rather not do it, so that when the hour of dire need draws nigh it may find you not unnerved and untrained to stand the test. Asceticism of this sort is like the insurance which a man pays on his house and goods. The tax does him no good at the time, and possibly may never bring him a return. But if the fire does come, his having paid it will be his salvation from ruin. So with the man who has daily inured himself to habits of concentrated attention, energetic volition, and self-denial in unnecessary things. He will stand like a tower when everything rocks around him, and when his softer fellow mortals are winnowed like chaff in the blast.—JAMES *Psychology*, vol. i, ch. 4, p. 126. (H. H. & Co., 1899.)

1496. HIGHWAYS, MODERN, FOLLOW ANCIENT BEACHES—*The "Ridge Road."*—Long curving ridges of gravel having the appearance of great railroad embankments, following the general trend of the shores of Lakes Ontario and Erie, but usually at a distance of several miles from their present borders, were noticed at an early day in the settlement of New York, Ohio, and Ontario, and correctly interpreted as being the records of previous high-water stages of the lakes they encircle. These ridges became highways of travel as civilization advanced, and gave origin to the term "ridge road," still to be seen on local maps of the region referred to. These ridges and other associated records have claimed the attention of geologists and others, and have been made the subject of special inquiry. The territory traversed by them is so extensive, however, that their study is still far from complete.—RUSSELL *Lakes of North America*, ch. 6, p. 96. (G. & Co., 1895.)

1497. HISTORY AND PHILOSOPHY—*Their Provinces Distinct.*—In the first place I have discarded the title of the "doctrine of creation," because my present business is not with the question why the objects which constitute Nature came into existence, but when they came into existence and in what order. This is as strictly a historical question as the question when the Angles and the Jutes invaded England, and whether they preceded or followed the Romans. But the question about creation is a philosophical problem, and one which can-

not be solved or even approached by the historical method. What we want to learn is whether the facts, so far as they are known, afford evidence that things arose in the way described by Milton, or whether they do not; and when that question is settled it will be time enough to inquire into the causes of their origination.—HUXLEY *American Addresses,* lect. 1, p. 18. (A., 1877.)

1498. HISTORY HAS NO RECORDS OF AGE OF STONE—Altho our knowledge of ancient times has of late years greatly increased, it is still very imperfect, and we cannot afford to neglect any possible source of information. It is evident that history cannot throw much light on the early condition of man, because the discovery—or, to speak more correctly, the use—of metal has in all cases preceded that of writing. Even as regards the Age of Bronze, we derive little information from history; and altho, as we have seen, the Age of Stone is vaguely alluded to in the earliest European writers, their statements have generally been looked upon as imaginative rather than historical, and contain, indeed, little more than the bare statement that there was a time when metal was unknown.—AVEBURY *Prehistoric Times,* ch. 13, p. 404. (A., 1900.)

1499. HISTORY IN THE ROCKS—*Geological Evidences of Life in the Past.*—The geologist has been able to turn back a few leaves of the earth's past history, and tho the pages have been defaced and mutilated by Time's unsparing hand, he is yet able to read in them of many strange vicissitudes to which the continents and oceans of our globe have been exposed. . . . He can, indeed, find the scattered remains of only a few of those old-world creatures; but he recognizes in those which have been preserved the clearest evidence that thousands of others must have existed around them. He knows that of a million creatures now existing scarcely one will leave to future ages any record of its existence; he sees whole races vanishing from the earth, leaving no trace behind them; and he is thus able to form an estimate of the enormous extent by which the creatures and races of which he can learn nothing must have outnumbered those whose scattered remains attest their former existence upon the earth.—PROCTOR *Other Worlds than Ours,* vol. i, p. 22. (Burt.)

1500. HISTORY OF MAN A HISTORY OF PROGRESS—Taken as a whole, the history of man is the history of his progressive development. It is true that everywhere and at all times we may notice individual retrogressions, or observe that crooked roads towards progress have been taken which lead only towards one-sided and external perfecting, and thus deviate more and more from the higher goal of internal and enduring perfecting. However, on the whole, the movement of development of all mankind is and remains a progressive one.—HAECKEL *History of Creation,* vol. i, ch. 12, p. 320. (K. P. & Co., 1899.)

1501. HOME, DECORATION OF—*The Original Form of Carpets.*—On festival occasions the floor had to be decorated with green, through which flowers were worked. In the winter that could only be accomplished imperfectly, and they were obliged to be satisfied with a layer of hay; but in the summer there were grass and leaves and flowers in plenty, and no house was so rich or poor but that on every festival the floor was thus decorated. The Edda testifies to this ancient custom.—GOETZ *Altnordisches Kleinleben und die Renaissance* (a lecture). (Translated for *Scientific Side-Lights.)*

1502. HOME OF THE CONDOR—*A Dweller in the Upper Air—Capacity for Change of Atmospheric Pressure.*—The region which may be regarded as the common resort of the condor begins at the elevation of Mount Etna. It embraces atmospheric strata which are from 10,000 to 19,000 feet above the level of the sea. Humming-birds also, which in their summer flights advance as far as 61° north lat. on the western coast of America, and are on the other hand found in the Archipelago of the Terra del Fuego, were seen by Von Tschudi in Puna at an elevation of 14,600 feet. There is a pleasure in comparing the largest and the smallest of the feathered inhabitants of the air. The largest among the condors found in the Cordilleras, near Quito, measure nearly 15 feet across the expanded wings. This size and the visual angle at which the birds are seen vertically above one's head afford an idea of the enormous height to which the condor soars in a clear sky. A visual angle of four minutes, for instance, would give a vertical elevation of 7,330 feet. The cavern (Mackay) of Antisana, opposite the mountain of Chussulongo, and where we measured the birds soaring over the chain of the Andes, lies at an elevation of nearly 16,000 feet above the surface of the Pacific; the absolute height which the condor reached must therefore be 23,273 feet, a height at which the barometer scarcely stands at 12.7 inches, but which, however, does not exceed that of the loftiest summit of the Himalaya. It is a remarkable physiological phenomenon that the same bird, which wheels for hours together through these highly rarefied regions, should be able suddenly, as for instance on the western declivity of the volcano of Pichincha, to descend to the seashore, and thus in the course of a few hours traverse, as it were, all climates. At heights of 23,000 feet and upwards the membranous air-sacs of the condor must undergo a remarkable degree of inflation after being filled in lower regions of the atmosphere.—HUMBOLDT *Views of Nature,* p. 237. (Bell, 1896.)

1503. HOMES, MIGRATORY BIRDS RETURN TO—*Wonderful Local Memory of Swallows Proved.*—The individual swallow,

it is now ascertained, returns from the Canaries or North Africa to the very spot on which it built its little mud mansion the previous summer, and according to the observations of the celebrated Jenner marked birds were caught at their old nests every year for three successive seasons. This fact is so remarkable that, even after allowing that the swallow tribe are gifted with extraordinary powers of localization, and that their summer homes are well defined, it is something wonderful to remember that a bird after seven months' absence can still have treasured up in its memory, through the varied fortunes and vicissitudes of two long journeys, the recollection of the landmarks necessary to guide it to and from its summer home.—BROWN *Nature-Studies*, p. 15. (Hum., 1888.)

1504. HOMOGENEOUSNESS, ASSUMED, OF MICROSCOPIC CELLS—*Properties of Water Elude Microscope.*—Let me say here that many of our physiological observers appear to form a very inadequate estimate of the distance which separates the microscopic from the molecular limit, and that, as a consequence, they sometimes employ a phraseology calculated to mislead. When, for example, the contents of a cell are described as perfectly homogeneous or as absolutely structureless, because the microscope fails to discover any structure; or when two structures are pronounced to be without difference, because the microscope can discover none, then I think the microscope begins to play a mischievous part. A little consideration will make it plain that the microscope can have no voice in the question of germ structure. Distilled water is more perfectly homogeneous than any possible organic germ. What is it that causes the liquid to cease contracting at 39° F., and to expand until it freezes? We have here a structural process of which the microscope can take no note, nor is it likely to do so by any conceivable extension of its powers.—TYNDALL *Fragments of Science*, vol. ii, ch. 8, p. 125. (A., 1897.)

1505. HOPE AND FAITH OPPOSE MATERIALISM—For there are two great enemies to materialism—one rooted in the affections, the other in the intellect. One is the power of things hoped for—a power which never dies; the other is the evidence of things not seen—and this evidence abounds in all we see. In reenforcing this evidence, and in adding to it, science is doing boundless work in the present day. It is not the extent of our knowledge, but rather the limits of it, that physical research teaches us to see and feel the most. Of course, in so far as its discoveries are really true, its influence must be for good. To doubt this were to doubt that all truth is true, its influence must be for good. To *Reign of Law*, ch. 2, p. 69. (Burt.)

1506. HOPE FOR HUMANITY'S FUTURE—*Past Gives Assurance.*—Thus, then, the most sanguine hopes for the future are justified by the whole experience of the past. It is surely unreasonable to suppose that a process which has been going on for so many thousand years should have now suddenly ceased; and he must be blind indeed who imagines that our civilization is unsusceptible of improvement, or that we ourselves are in the highest state attainable by man.—AVEBURY *Prehistoric Times*, ch. 16, p. 576. (A., 1900.)

1507. HOPEFULNESS OF SCIENCE—*Perplexities Yet Remaining.*—It must be admitted that we do not at present appear to have the means for framing a complete and consistent theory of volcanic action, but we may hopefully look forward to the time when further observation and experiment shall have removed many of the existing difficulties which beset the question, and when by the light of such future researches untenable hypotheses shall be eliminated and the just ones improved and established. —JUDD *Volcanoes*, ch. 12, p. 360. (A., 1899.)

1508. HORIZON, MENTAL, EXTENDED—*Individual Experience Not the Limit—History, Etymology, Mythology, and Religion Tributary to Psychology.*—But how is it possible to extend our experience of sensations, feelings, and thoughts? Did not mankind feel and think thousands of years ago as it feels and thinks to-day? It does, indeed, seem as tho our observation of what goes on in the mind could never extend beyond the circle to which our own consciousness confines it. But appearances are deceptive. Long ago the step was taken which raised the science of psychology above the level of this its first beginning, and extended its horizon almost indefinitely. History, dealing with the experience of all times, has furnished us with a picture in the large of the character, the impulses, and the passions of mankind. More especially is it the study of language and linguistic development, of mythology, and the history of religion and custom, which has approached more and more closely, as historical knowledge has increased, to the standpoint of psychological inquiry.—WUNDT *Psychology*, lect. 1, p. 10. (Son. & Co., 1896.)

1509. HORSE A MIGHTY ENGINE—*Adaptation to Needs of Man.*—The teeth of a horse are not less peculiar than its limbs. The living engine, like all others, must be well stoked if it is to do its work; and the horse, if it is to make good its wear and tear, and to exert the enormous amount of force required for its propulsion, must be well and rapidly fed. To this end, good cutting instruments and powerful and lasting crushers are needful. Accordingly, the twelve cutting teeth of a horse are close-set and concentrated in the fore part of its mouth, like so many adzes or chisels. The grinders or molars are large, and have an

extremely complicated structure, being composed of a number of different substances of unequal hardness. The consequence of this is that they wear away at different rates; and, hence, the surface of each grinder is always as uneven as that of a good millstone.—HUXLEY *American Addresses*, lect. 3, p. 76. (A., 1898.)

1510. HORSES, EXTINCT, IN AMERICA BEFORE COLUMBUS—It is a singular fact that, altho no horse inhabited America when discovered by Europeans, yet abundance of remains of extinct horses have been found both in North and South America in post-Tertiary and Upper Pliocene deposits; and from these an almost continuous series of modified forms can be traced in the Tertiary formation, till we reach, at the very base of the series, a primitive form so unlike our perfected animal that, had we not the intermediate links, few persons would believe that the one was the ancestor of the other.—WALLACE *Darwinism*, ch. 13, p. 260. (Hum., 1889.)

1511. HOST OF MINUTE PARTICLES, INNUMERABLE—*Unbroken Blue of Sky.*—Small in mass, the vastness in point of number of the particles of our sky may be inferred from the continuity of its light. It is not in broken patches, nor at scattered points, that the heavenly azure is revealed. To the observer on the summit of Mont Blanc, the blue is as uniform and coherent as if it formed the surface of the most close-grained solid. A marble dome would not exhibit a stricter continuity. . . . By day, this light quenches the stars; even by moonlight it is able to exclude from vision all stars between the fifth and the eleventh magnitude. It may be likened to a noise, and the feebler stellar radiance to a whisper drowned by the noise.—TYNDALL *Fragments of Science*, vol. ii, ch. 8, p. 122. (A., 1897.)

1512. HUES OF ANIMALS IN OCEAN DEPTHS OFTEN RICH AND BRILLIANT—Agassiz, in his narrative of the voyage of the "Blake," records that "some of the deep-sea corals are scarlet, deep flesh-colored, pinkish orange, and of other colors," and in referring to the Gorgonian *Iridogorgia* he says: "The species are remarkable for their elegance of form and for the brilliant luster and iridescent colors of the axis, in some of a bright emerald green, in others like burnished gold or mother-of-pearl."—HICKSON *Fauna of the Deep Sea*, ch. 4, p. 66. (A., 1894.)

1513. HUMANITY, ASCENDING SCALE OF—*The Highest Man Serves Distant Ends.*—Within the psychic life due to the cerebrum itself the same general distinction obtains, between considerations of the more immediate and considerations of the more remote. In all ages the man whose determinations are swayed by reference to the most distant ends has been held to possess the highest intelligence. The tramp who lives from hour to hour; the bohemian whose engagements are from day to day; the bachelor who builds but for a single life; the father who acts for another generation; the patriot who thinks of a whole community and many generations; and finally, the philosopher and saint whose cares are for humanity and for eternity—these range themselves in an unbroken hierarchy, wherein each successive grade results from an increased manifestation of the special form of action by which the cerebral centers are distinguished from all below them.—JAMES *Psychology*, vol. i, ch. 2, p. 23. (H. H. & Co., 1899.)

1514. HUMANITY DETHRONED—*Atheism and Materialism Result.*—Once dethrone humanity, regard it as a mere local incident in an endless and aimless series of cosmical changes, and you arrive at a doctrine which, under whatever specious name it may be veiled, is at bottom neither more nor less than atheism. On its metaphysical side atheism is the denial of anything psychical in the universe outside of human consciousness; and it is almost inseparably associated with the materialistic interpretation of human consciousness as the ephemeral result of a fleeting collocation of particles of matter. Viewed upon this side, it is easy to show that atheism is very bad metaphysics, while the materialism which goes with it is utterly condemned by modern science.—FISKE *Destiny of Man*, ch. 1, p. 12. (H. M. & Co., 1900.)

1515. HUMANITY IN ACCORD WITH HIGHER LAW—*Wholesome Restrictions on Labor.*—But as it needed the practical results of restriction—distress, discontent, and the danger of civil commotion—to bring home to the national understanding the economic error of the old commercial systems [the Corn Laws, etc.]; so also as regards the grievous results of unrestricted competition in human labor, our only effective teaching has been that of hard experience. The doctrines of Adam Smith, when applied here, were a hindrance and not a help. The political economists were, almost to a man, hostile to restrictive legislation. They did not see what would be the working of natural law upon the human will, when that will was exposed to overpowering motives under debased conditions of understanding and of heart. They did not see the higher law which Parliament was asserting when it was driven, by sheer instinctive horror of actual results, to prohibit "free" laborers from disposing as they pleased of the labor of their children.—ARGYLL *Reign of Law*, ch. 7, p. 216. (Burt.)

1516. HUMANITY RESULTS IN UTILITY—*Anesthetics Deaden Pain for Patient—Give Surgeon Calmness and Confidence.*—Anesthetics were first used in dentistry in 1846, the agent being ether, while chloroform, for more severe surgical operations,

was adopted in 1848; and tho their primary effect is only to abolish pain, they get rid of so much nervous irritation as greatly to aid in the subsequent recovery. The use of anesthetics thus renders it possible for many operations to be safely performed which, without it, would endanger life by mere shock to the system; while to the operating surgeon it gives confidence, and enables him to work more deliberately and carefully, from the knowledge that the longer time occupied will not increase the suffering of the patient or render his recovery less probable.—WALLACE *The Wonderful Century*, ch. 14, p. 147. (D. M. & Co., 1899.)

1517. HUMMING-BIRDS, HYBRIDISM NOT FOUND AMONG—*Numerous Species Keep Distinct.* — We have the emphatic declaration of Mr. Gould that among the thousands of specimens which have passed through his hands, from all the genera of this great family, he has never seen one case of mixture or hybridism between any two species, however nearly allied. But this passage is so important that I quote it entire: "It might be thought by some persons that four hundred species of birds so diminutive in size, and of one family, could scarcely be distinguished from each other; but any one who studies the subject will soon perceive that such is not the case. Even the females, which assimilate more closely to each other than the males, can be separated with perfect certainty; nay, even a tail-feather will be sufficient for a person well versed in the subject to say to what genus and species the bird from which it has been taken belongs. I mention this fact to show that what we designate a species has really distinctive and constant characters; and in the whole of my experience, with many thousands of humming-birds passing through my hands, I have never observed an instance of any variation which would lead me to suppose that it was the result of a union of two species. I write this without bias one way or the other as to the question of the origin of species. I am desirous of representing Nature in her wonderful ways as she presents herself to my attention at the close of my work, after a period of twelve years of incessant labor, and not less than twenty years of interesting study."—ARGYLL *Reign of Law*, ch. 5, p. 141. (Burt.)

1518. HUMMING-BIRDS IN SNOW-STORM—*Insect Food of Flower-loving Birds.* —Two species of humming-birds are common. *Trochilus forficatus* is found over a space of 2,500 miles on the west coast, from the hot, dry country of Lima to the forests of Terra del Fuego—where it may be seen flitting about in snow-storms. In the wooded island of Chiloe, which has an extremely humid climate, this little bird, skipping from side to side amidst the dripping foliage, is perhaps more abundant than almost any other kind. I opened the stomachs of several specimens, shot in different parts of the continent, and in all remains of insects were as numerous as in the stomach of a creeper. When this species migrates in the summer southward, it is replaced by the arrival of another species coming from the north. This second kind *(Trochilus gigas)* is a very large bird for the delicate family to which it belongs; when on the wing its appearance is singular. Like others of the genus, it moves from place to place with a rapidity which may be compared to that of *Syrphus* amongst flies, and *Sphinx* among moths; but whilst hovering over a flower, it flaps its wings with a very slow and powerful movement, totally different from that vibratory one common to most of the species, which produces the humming noise. I never saw any other bird where the force of its wings appeared (as in a butterfly) so powerful in proportion to the weight of its body. When hovering by a flower its tail is constantly expanded and shut like a fan, the body being kept in a nearly vertical position. This action appears to steady and support the bird, between the slow movements of its wings. Altho flying from flower to flower in search of food, its stomach generally contained abundant remains of insects, which I suspect are much more the object of its search than honey. The note of this species, like that of nearly the whole family, is extremely shrill.—DARWIN *Naturalist's Voyage around the World*, ch. 12, p. 271. (A., 1893.)

1519. HUNTING, A NATURAL IMPULSE — *Inherited Tendencies to Cruelty—Resolute Endeavor Needed to Overcome.*— The hunting instinct has a remote origin in the evolution of the race. The hunting and the fighting instinct combine in many manifestations. They both support the emotion of anger; they combine in the fascination which stories of atrocity have for most minds; and the utterly blind excitement of giving the rein to our fury when our blood is up (an excitement whose intensity is greater than that of any other human passion save one) is only explicable as an impulse aboriginal in character, and having more to do with immediate and overwhelming tendencies to muscular discharge than to any possible reminiscences of effects of experience or association of ideas. I say this here because the pleasure of disinterested cruelty has been thought a paradox, and writers have sought to show that it is no primitive attribute of our nature, but rather a resultant of the subtile combination of other less malignant elements of mind. This is a hopeless task. If evolution and the survival of the fittest be true at all, the destruction of prey and of human rivals must have been among the most important of man's primitive functions, the fighting and the chasing instincts must have become ingrained. . . . It is just because human bloodthirstiness is such a primitive

part of us that it is so hard to eradicate, especially where a fight or a hunt is promised as part of the fun.—JAMES *Psychology*, vol. ii, ch. 24, p. 411. (H. H. & Co., 1899.)

1520. HYPNOTISM, EFFECTS OF—*Power of Resistance Diminished—Mind Follows Accustomed Track—Judgment Beclouded.*—It [hypnotism] must be looked upon, not as a remedy of universal serviceability, but as a poison whose effect may be beneficial under certain circumstances. We find, of course, not only the dabbler in hypnotism—who has no claim to a judgment on the question, and in whose hands the practise of suggestion becomes a public nuisance—but also the physician—to whom thinking men will no more deny the right to employ this dangerous remedy in certain circumstances than that of using any other—asserting that the hypnotic sleep is not injurious, because it is not in itself a pathological condition. But surely the facts of post-hypnotic hallucination and the diminution of the power of resistance to suggestive influences furnish a refutation of this statement which no counter-arguments can shake. It is a phenomenon of common observation that frequently hypnotized individuals can when fully awake be persuaded of the wildest fables, and thenceforth regard them as passages from their own experience.—WUNDT *Human and Animal Psychology*, lect. 22, p. 335. (Son. & Co., 1896.)

1521. HYPNOTISM MAY INJURE BODY AND MIND—The chief danger of all this [unregulated use of hypnotism], it seems to me, does not lie in the abuse of post-hypnotic suggestion for criminal purposes, which may happen once in a while. Crimes have hardly as yet been committed by "mediums" as a result of suggestion. No! the great danger is that persons of insufficient medical training, working not for therapeutic ends, but "in the interests of science"—tho there is absolutely no guaranty of the real existence of their scientific devotion—may exert an influence upon the mental and bodily life of their fellow men such as, if continued for any length of time together, cannot fail to be injurious.—WUNDT *Psychology*, lect. 22, p. 336. (Son. & Co., 1896.)

1522. HYPOTHESIS OF A DESIGNING MIND—The idea or hypothesis of a designing mind, as the author of Nature—however we came by it—having possession of the field, and being one which man, himself a designer, seemingly must needs form, cannot be rivaled except by some other equally adequate for explanation, or displaced except by showing the illegitimacy of the inference. —GRAY *Darwiniana*, art. 13, p. 360. (A., 1889.)

1523. HYPOTHESIS OF A SOUL IS SATISFYING—I confess, therefore, that to posit a soul influenced in some mysterious way by the brain-states, and responding to them by conscious affections of its own, seems to me the line of least logical resistance, so far as we yet have attained.—JAMES *Psychology*, vol. i, ch. 6, p. 181. (H. H. & Co., 1899.)

1524. HYPOTHESIS OF PRIMARY ELEMENTS—*Originated Probably in India—Natural Tendency of Human Mind To Seek Underlying Principles of the Universe.*—After men had for a long time, in accordance with the earliest ideas of the Hellenic people, venerated the agency of spirits, embodied in human forms, in the creative, changing, and destructive processes of Nature, the germ of a scientific contemplation developed itself in the physiological fancies of the Ionic school. The first principle of the origin of things, the first principle of all phenomena, was referred to two causes—either to concrete material principles, the so-called elements of Nature, or to processes of rarefaction and condensation, sometimes in accordance with mechanical, sometimes with dynamic views. The hypothesis of four or five materially differing elements, which was probably of Indian origin, has continued, from the era of the didactic poem of Empedocles down to the most recent times, to imbue all opinions on natural philosophy—a primeval evidence and monument of the tendency of the human mind to seek a generalization and simplification of ideas, not only with reference to the forces, but also to the qualitative nature of matter. —HUMBOLDT *Cosmos*, vol. iii, p. 11. (H., 1897.)

1525. HYPOTHESIS, THE NEBULAR—*Formation of the Earth—A Gaseous Ring Detached from the Sun.*—Thus the earth was formed by the slow condensation of a gaseous ring detached from the sun, which, continuing afterwards to contract and to condense, gave birth later on to Venus and to Mercury. The terrestrial nebula had from that time an independent existence. It proceeded slowly to form an immense gaseous globe turning upon itself; thus condensed, heated by the molecular and constant clashing together of all the materials which compose it, the new-born earth shone with a feeble glimmer in the gloomy night of space.

From a gaseous condition it became liquid, then solid, and doubtless it continues to cool and contract even now. But its mass increases from age to age by the meteoric stones and shooting stars which continually fall upon it (more than a hundred thousand millions per annum). Will the sun give birth to a new earth? This is not probable. For this purpose it would be necessary that its rotation should be enormously accelerated; it should be 219 times more rapid.—FLAMMARION *Popular Astronomy*, pp. 73-74. (A.)

1526. ——— ——— *Objections Stated —The Best Theory That Which Best Accounts for All the Facts.*—But this ingeni-

ous theory [the nebular hypothesis] does not account for some peculiarities which are scarcely less remarkable than those on which it has been based. In particular it does not account for the strange disposition of the masses of the solar system. Why should the inner family consist of minor bodies, in the main unattended, while the outer consists of giant orbs with extensive families of satellites? Why should the innermost members of the outer family of planets be the largest, while just within there lies the family of asteroids, not only individually minute, but collectively less (as Le Verrier has proved) than Mars or even Mercury? Why should the two middle planets of the inner family be the largest members of that family? Laplace's theory gives no account of these peculiarities, nor perhaps could it be insisted that these peculiarities should be explained; yet, if any other theory should give an account of these features, explaining also the features which we have seen accounted for, then such theory would have a decided advantage over Laplace's. It is to be noticed also that Laplace's great nebulous contracting mass is a very unsatisfactory conception to begin with. No such mass could rotate as a whole. And lastly, Laplace's theory does not in any way correspond with processes still taking place within the solar system. It gives no account of the immense number of meteor-flights and comets still existing within the solar domain.—PROCTOR *Expanse of Heaven*, p. 182. (L. G. & Co., 1897.)

1527. ——— ——— *Opposed by Analysis of Existing Nebulæ.*—We have vast gaseous masses intermingled with and surrounding groups of stars, and apparently spread with exceptional richness where these stars or suns are most densely aggregated. But this is not what we should expect to find if stars were formed out of this gaseous matter. On the contrary, we should expect that where stars were most numerous there the nebulous matter would have been most completely used up, so to speak—exhausted, as it were, in the work of star-making. Nor, again, can we recognize in the substances which appear to constitute the gaseous nebulæ the fitting materials for making stars. So far as the spectroscopic analysis of the gaseous nebulæ extends, their chief constituent would appear to be the gas nitrogen, the element next in importance in their constitution being the gas hydrogen, while a third element, as yet not identified, seems to be present in their substance. I would not insist too much on this evidence; but it must not be forgotten that it is all the evidence we have; and it must be regarded as at least an unsatisfactory basis on which to rear the hypothetical development of suns like our own, in whose orb exist the glowing vapors of iron, copper, and zinc, sodium, antimony, and mercury, barium, carbon, silicon, and sulfur, and probably every single element known to our chemists.—PROCTOR *Our Place among Infinities*, p. 229. (L. G. & Co., 1897.)

1528. HYPOTHESIS VERIFIED BY EXPERIMENT—*The Undulatory Theory of Light—Conflicting Waves of Light Produce Darkness.*—Every new hypothesis of scientific value must not only furnish an exact explanation of known facts, but must also enable us to predict in kind and quantity—the phenomena which will be exhibited under any given combination of circumstances. Thus, in the case of the undulatory hypothesis of light, it was inferred as a logical consequence that if the supposition were true that light consisted of waves of an ethereal medium, then two rays of light, like two waves of water under certain conditions, should annihilate each other, and darkness be produced. The experiment was tried, and the anticipated result was obtained. It is this exact agreement of the deduction with the actual result of experience that constitutes the verification of a hypothesis, and which alone entitles it to the name of a theory, and to a place in the transactions of a scientific institution. It must be recollected that it is much easier to speculate than to investigate, and that very few of all the hypotheses imagined are capable of standing the test of scientific verification.—HENRY *Organization of Smithsonian Institution, Scientific Writings*, vol. i, p. 276. (Sm. Inst., 1886.)

1529. ICE A MILE AND A HALF IN DEPTH—*Interior of Greenland an Unknown Land.*—The interior of Greenland is reported by the few bold explorers who have crossed it to be completely buried beneath a featureless plain of snow. This covering has reached such a depth in all of the central part that not a single mountain peak is known to break the even monotony of its surface. The snow is highest and probably deepest in the central area, and descends toward the coast, thus giving the island a convex surface. The general elevation of the central portion is from 7,000 to 8,000 feet, decreasing gradually toward the coast, especially to the east and west, where the glaciers, protruding like great tongues of ice from the central region, come down to the sea. The only mountain peaks that rise above the surface of the general covering of snow are within from 50 to 75 miles of the coast. These partially buried peaks rise like islands in the sea of white. They are known to the inhabitants of the coast as *nunataks*, a convenient name that has found a place in geological literature.

The depth of the nearly universal covering of snow and ice under which Greenland is buried cannot be told, as it is impossible to determine the topography of the land beneath. The best estimates that can be made place its depth at several thousand feet. In the central portion, where the covering is apparently thickest, its

depth may be fully equal to the height of the surface above the sea, or about 8,000 feet.—RUSSELL *Glaciers of North America*, ch. 7, p. 133. (G. & Co., 1897.)

1530. ICE, CONTINUED ACTIVITY OF—At the first freezing, water, like any other substance, shrinks, but with increasing cold it expands, and in fact to such an extent that it breaks every limiting barrier, a proceeding during which it actually becomes lighter, consequently it must be constantly changing its inner structure, must be constantly developing. It is by means of this activity of ice that it gradually works to the surface the immense granite blocks which sink deep under the ice high up on the glacier. Glacial ice never contains enclosed fragments of rock.—BUCHHEISTER *Eine wissenschaftliche Alpenreise im Winter, 1832*, p. 16. (Translated for *Scientific Side-Lights.)*

1531. ICE EXPANDS BY MEANS OF AIR-BUBBLES—Glacier-ice is everywhere found honeycombed by a system of air-bubbles. Every icy surface that forms over quiet water contains a countless number of air-holes in very regular layers, of which the upper are all thin and pointed, like a bodkin, all of whose outermost sharp points turn toward the atmosphere. All of the fundamental strata of river-ice contain a complication of bubbles and nets of bubbles, that remind one of cell-tissues. The active development of these bubbles increases with the degree of cold and the formation of ice, and is the obvious reason why ice expands.—BUCHHEISTER *Eine wissenschaftliche Alpenreise im Winter, 1832*. (Translated for *Scientific Side-Lights.)*

1532. ICE, FAIRY-LAND OF—*Beauty of Alaskan Glaciers—Rich and Varied Colors—The Blue of the Crystal Mass.*—The color of the fractured and cleft ice-cliffs [of Taku glaciers] is as varied and beautiful as their ever-changing forms. The surfaces that have been longest exposed to the atmosphere are white and glittering, on account of the multitude of vesicles formed in the partially melted ice; but the clefts and caverns reveal the intense blue of the crystal mass within. In the deeper recesses the light issuing from the interior is of the darkest ultramarine, so deep that it appears almost black in contrast with the brilliant outer surface. In the full glory of an unclouded summer day the scene becomes resplendent with the reflected glories of the sea and sky. The ice-cliffs blaze and flash in the sunlight until one can scarcely believe that it is ah every-day, earthly scene that meets his admiring gaze. The observer to whom such wonders are novel may well fancy that the picture before him is but the fantasy of a dream. One is awakened from such reverie, however, by a crash like the roar of artillery, when an avalanche falls from the cliffs of light and is engulfed in the turbid waters below. The white foam shot upwards by the avalanche rises high on the icy precipice, and perhaps dislodges other tottering pinnacles, which reawaken the echoes in the neighboring mountains. After each crash, crested waves, starting away from the scene of commotion, set numerous bergs rocking, and break in lines of foam on the adjacent shore.—RUSSELL *Glaciers of North America*, ch. 6, p. 79. (G. & Co., 1897.)

1533. ICE REMOLDED BY BREAKING AND FREEZING—*Fracture and Regelation.*—[Investigation] suggested the thought that if a piece of ice—a straight prism, for example—were placed in a bent mold and subjected to pressure it would break, but that the force would also bring its ruptured surfaces into contact, and thus the continuity of the mass might be reestablished. Experiment . . . completely confirmed this surmise; the ice passed from a continuous straight bar to a continuous bent one, the transition being effected, not by a viscous movement of the particles, but through fracture and regelation.

Let the transition from curve to curve be only gradual enough, and we have the exact case of a transverse slice of a glacier. —TYNDALL *Hours of Exercise in the Alps*, ch. 1, p. 354. (A., 1898.)

1534. ICE SUPPOSED TO BE FORMED BY HEAT—*Physical Conceptions of the Ancients—Supposed Law of Contraries.*—The ideas that fire has the power of making rigid, . . . and that the formation of ice itself may be promoted by heat, are deeply rooted in the physics of the ancients and based on a fanciful theory of contraries *(Antiperistasis)*—on obscure conceptions of polarity (of exciting opposite qualities or conditions). . . . The quantity of hail produced was considered to be proportional to the degree of heat of the atmospheric strata. In the winter fishery on the shores of the Euxine, warm water was used to increase the ice formed in the neighborhood of an upright tube.—HUMBOLDT *Cosmos*, vol. iii, p. 125. (H., 1897.)

1535. ICE, TRANSPORTING POWER OF—*Rocks Borne Along Like Chips.*—In Canada, where the winter's cold is intense, in a latitude corresponding to that of central France, several tributaries of the St. Lawrence begin to thaw in their upper course, while they remain frozen over lower down, and thus large slabs of ice are set free and thrown upon the unbroken sheet of ice below. Then begins what is called the packing of the drifted fragments; that is to say, one slab is made to slide over another, until a vast pile is built up, and the whole, being frozen together, is urged onwards by the force of the dammed-up waters and drift-ice. Thus propelled, it not only forces along boulders, but breaks off from cliffs, which border the rivers, huge pieces of projecting rock. By this means several buttresses of solid masonry, which up to the year 1836

supported a wooden bridge on the St. Maurice, which falls into the St. Lawrence near the town of Trois Rivières, lat. 46° 20′, were thrown down and conveyed by the ice into the main river; and instances have occurred at Montreal of wharfs and stone buildings, from 30 to 50 feet square, having been removed in a similar manner. We learn from Captain Bayfield that anchors laid down within high-water mark, to secure vessels hauled on shore for the winter, must be cut out of the ice on the approach of spring, or they would be carried away. In 1834 the "Gulnare's" bower-anchor, weighing half a ton, was transported some yards by the ice, and so firmly was it fixed that the force of the moving ice broke a chain cable suited for a 10-gun brig, and which had rode the "Gulnare" during the heaviest gales in the gulf. Had not this anchor been cut out of the ice it would have been carried into deep water and lost.—LYELL *Principles of Geology*, bk. ii, ch. 15, p. 220. (A., 1854.)

1536. ICE, TROPICAL ANIMALS EMBALMED IN—*Glacial Epoch Came as a Surprise.*—The long summer was over. For ages a tropical climate had prevailed over a great part of the earth, and animals whose home is now beneath the equator roamed over the world from the far south to the very borders of the arctics. The gigantic quadrupeds, the mastodons, elephants, tigers, lions, hyenas, bears, whose remains are found in Europe from its southern promontories to the northernmost limits of Siberia and Scandinavia, and in America from the Southern States to Greenland and the Melville Islands, may indeed be said to have possessed the earth in those days. But their reign was over. A sudden intense winter, that was also to last for ages, fell upon our globe; it spread over the very countries where these tropical animals had their homes, and so suddenly did it come upon them that they were embalmed beneath masses of snow and ice, without time even for the decay which follows death.—AGASSIZ *Geological Sketches*, ser. i, ch. 8, p. 208. (H. M. & Co., 1896.)

1537. ICEBERGS, COLORS OF—*Blue, Gray, and White—Color Changed by Sudden Revolution—Buoyancy Causes Overthrow.*—In sailing up Muir Inlet or any other arm of the sea on the wild Alaskan shore where tide-water glaciers discharge, one notices that the bergs vary in character, but may be grouped in three quite well-defined classes. Some are of dazzling whiteness; others are of the color of turquoise or beryl; others again are dark with dirt and stones. On watching the ice-cliffs where these children of the glaciers are born, we find that when pinnacles already whitened by exposure to the air fall into the sea, they float away as white bergs. If we watch them drifting over the still water and appearing in the distance like a fleet of gleaming sails, we note that occasionally a white berg suddenly turns over with great commotion and joins the fleet having blue for their banner. The reason for the change in color is that, previous to turning over, the porous exterior of the submerged portion of the berg was dissolved away so as to expose the compact ice of the interior. The sudden reversion of position is due to unequal melting, which changes the center of gravity of the mass. A cone of ice in which the height is about equal to the diameter of the base will float with its apex down. When a berg approaches a conical form the position of greatest stability is one in which the side having the larger mass is uppermost. Bergs do not become *top-heavy* and turn over, as is sometimes stated, but become *bottom-buoyant* and tend to adjust themselves to the medium in which they float.—RUSSELL *Glaciers of North America*, ch. 6, p. 83. (G. & Co., 1897.)

1538. ——— ——— *The Blue Bergs from under Sea—Commotion Attends Emancipation.*—Blue bergs are also formed by the breaking away of portions of the submerged ice-foot of tide-water glaciers. These are frequently of large size, and rise from below the surface of the water well in advance of the visible end of the glacier. Their emergence is sudden. They bound to the surface, and rising well above it carry tons of water with them. After rocking to and fro for several minutes, as if to be sure of their freedom after centuries of imprisonment, they quiet down and float slowly away as shimmering islands of the most exquisite blue.—RUSSELL *Glaciers of North America*, ch. 6, p. 84. (G. & Co., 1897.)

1539. ICE-CLOUDS OF UPPER AIR—There is another form of cloud that is seen at this season of the year [summer] called cirrus (a curl). It takes the form of a curl at its ends. This cloud usually has a threaded shape and sometimes takes the form of a feather, and frequently forms are seen that remind you of frost-pictures on a window-pane. These clouds float very high in the atmosphere, away above the tops of the highest mountains, from six to eight miles above the level of the sea. They are formed only at a season of the year when the atmospheric conditions are most uniform. At certain times of the day and night the moisture will rise to this height before it condenses, and when it does condense it immediately freezes, which makes it take on these peculiar forms that would no doubt conform very closely to the frost-pictures on the window-pane if it were not for the disturbing influences of air currents at this altitude. The fact that they are ice- or frost-clouds instead of water-clouds gives them that peculiar whiteness and brightness of appearance. If ordinary clouds are water-dust, these high clouds may be called ice-dust. Sometimes we see them lying in bands or threads running across the sky in the direction that the wind blows. Their

form is undoubtedly a resultant of the struggle between the air currents and the tendency of crystallized water to arrange itself in certain definite lines or forms.—ELISHA GRAY *Nature's Miracles*, vol. i, ch. 9, p. 73. (F. H. & H., 1900.)

1540. ICE-CRYSTALS SHOWN IN SOLID BLOCK—*Revealing Power of Light—Hidden Structure Made Manifest.*—There is a way of showing the regularity in the structure of ice, a very simple and ingenious method devised by Professor Tyndall. His plan is this: he takes a slab of ice and causes a ray of light to pass through it at right angles to the surface of freezing, and then fall on a white screen behind Now this ray of light is accompanied by heat, and the heat serves partially to melt the ice through which it passes; but it does not melt a hole right through the ice; it melts a particle here and a particle there, and in doing so reveals the structure that was previously undiscernable. By melting a particle here and there the transparency of the ice is interrupted, and the screen now reveals a number of figures known as ice-flowers, each of which has a bright spot in the center, and, like a snow-crystal, has six rays, inclined to one another at precisely the same angle, and variously adorned with symmetrical outgrowths. — CHISHOLM *Nature-Studies*, p. 27. (Hum., 1888.)

1541. ICE-HOUSE, A NATURAL—*Frozen Drifts Buried for Ages—Siberian Mammoths.*—If it be true that the carcass of the mammoth was embedded in pure ice, there are two ways in which it may have been frozen in. We may suppose the animal to have been overwhelmed by drift-snow. I have been informed by Dr. Richardson that in the northern parts of America, comprising regions now inhabited by many herbivorous quadrupeds, the drift-snow is often converted into permanent glaciers. It is commonly blown over the edges of steep cliffs, so as to form an inclined talus hundreds of feet high; and when a thaw commences, torrents rush from the land and throw down from the top of the cliff alluvial soil and gravel. This new soil soon becomes covered with vegetation, and protects the foundation of snow from the rays of the sun. Water occasionally penetrates into the crevices and pores of the snow; but, as it soon freezes again, it serves the more rapidly to consolidate the mass into a compact iceberg. It may sometimes happen that cattle grazing in a valley at the base of such cliffs, on the borders of a sea or, river, may be overwhelmed and at length enclosed in solid ice, and then transported towards the polar regions.—LYELL *Principles of Geology*, bk. i, ch. 6, p. 85. (A., 1854.)

1542. ICE-SHEET OVER NORTHERN ITALY—*The Glacial Epoch.*—The glaciers on the southern sides of the Alps were hardly less extensive than on the northern. They descended the valleys, they passed over the sites of the Italian lakes and on to the plains of Piedmont and Lombardy. 'Round one group of moraines the tide of battle ebbed and flowed in the struggle of Solferino.—BONNEY *Ice-work, Present and Past*, pt. i, ch. 1, p. 35. (A., 1896.)

1543. ICE-STORMS IN FORESTS—*Melting Snow Congealed on Trees—Blocks of Ice Hurled Down.*—Snow may act destructively . . . by giving rise to what are known as ice-storms in forests. When snow falls in forests, and especially in forests of coniferous trees, such as are most abundant in those regions where snow falls most plentifully, the branches of these evergreens become laden with a heavy weight of snow, which they may bear until the snow has been converted by partial melting and subsequent refreezing into solid lumps of ice. These present a still greater surface for the reception of fresh snow, which may be converted into ice in its turn. Sometimes these accumulations attain such a weight that the branches can no longer support them. The topmost, weakest branches give way and fall down with the lumps of ice that they carry. These, acquiring impetus as they fall, strike against the lower branches and break them off. Thus the process of destruction is accelerated. The agitation is communicated to the contiguous trees, and from these to others, and thus in a brief space of time large areas in a forest may be in great part destroyed.—CHISHOLM *Nature-Studies*, p. 32. (Hum., 1888.)

1544. IDEA BEHIND PHENOMENA—*The First Law of Motion—Not One Instance of Its Operation Ever Known—Revealed to Scientific Faith Only.*—The law is that all motion is in itself (that is to say, except as affected by extraneous forces) uniform in velocity and rectilinear in direction. Thus according to this law a body moving, and not subject to any extraneous force, would go on moving forever at the same rate of velocity, and in an exactly straight line.

Now, there is no such motion as this existing on the earth or in the heavens. It is an abstract idea of motion which no man has ever or can ever see exemplified. Yet a clear apprehension of this abstract idea was necessary to a right understanding and to the true explanation of all the motions which are actually seen. It was long before this idea was arrived at. There was a real difficulty in conceiving it, because not only is there no such motion in Nature, but there is no possibility by artificial means of producing it. It is impossible to release any moving body from the impulses of extraneous force. The first law of motion is therefore a purely abstract idea. It represents a rule which never operates as we conceive it in itself, but is always complicated with other rules which produce a corre-

sponding complication in result. Like many other laws of the same class, it was discovered, not by looking outward, but by looking inward; not by observing, but by thinking. —ARGYLL *Reign of Law*, ch. 2, p. 65. (Burt.)

1545. IDEA OF MATHEMATICIAN REALIZED IN CRYSTAL—*Theory of Undulations Verified.*—Effects [of refraction] which, without a theoretic clue, would leave the human mind in a jungle of phenomena without harmony or relation, were organically connected by the theory of undulation.

The theory was applied and verified in all directions, Airy being especially conspicuous for the severity and conclusiveness of his proofs. The most remarkable verification fell to the lot of the late Sir William Hamilton, of Dublin, who, taking up the theory where Fresnel had left it, arrived at the conclusion that at four special points of the "wave-surface" in double-refracting crystals the ray was divided, not into two parts, but into an infinite number of parts, forming at these points a continuous conical envelope instead of two images. No human eye had ever seen this envelope when Sir William Hamilton inferred its existence. He asked Dr. Lloyd to test experimentally the truth of his theoretic conclusion. Lloyd, taking a crystal of aragonite, and following with the most scrupulous exactness the indications of theory, cutting the crystal where theory said it ought to be cut, observing it where theory said it ought to be observed, discovered the luminous envelope which had previously been a mere idea in the mind of the mathematician.—TYNDALL *Lectures on Light*, p. 212. (A., 1898.)

1546. IDEAS, ABSTRACT, OF SLOW GROWTH—*Not To Be Attributed to Primitive Man—Conception of Energy or Force Late and Difficult—Powers of Nature Regarded as Energies of Persons.*—When, again, we are told by Sanskrit scholars that the earliest religious conceptions of the Aryan race, as exhibited in the Veda, were pantheistic, and that the gods they worshiped were "deifications" of the forces or powers of Nature, we are to remember that this is an interpretation, and not a fact. It is an interpretation, too, which assumes the familiarity of the human mind, in the ages of its infancy, with one of the most doubtful and difficult conceptions of modern science—namely, the abstract conception of energy or force as an inseparable attribute of matter. The only fact, divested of all preconceptions, which these scholars have really ascertained is that in compositions which are confessedly poetical the energies of Nature were habitually addressed as the energies of personal or living beings. But this fact does not in the least involve the supposition that the energies of Nature which are thus addressed had, at some still earlier epoch, been regarded under the aspect of material forces, and had afterwards come to be personified; nor does it in the least involve the other supposition that, when so personified, they were really regarded as so many different beings absolutely separate and distinct from each other. Both of these suppositions may indeed be matter of argument, but neither of them can be legitimately assumed.—ARGYLL *Unity of Nature*, ch. 12, p. 303. (Burt.)

1547. IDEAS NOT OBJECTS, BUT PROCESSES—*Comparison of Thinking to Writing.*—As a matter of fact, ideas, like all other mental experiences, are not objects, but processes, occurrences. The idea which we refer back to a previous one, when we apprehend it as similar to that, is no more the earlier idea itself than the word which we write or the picture which we draw is identical with the same word which we wrote previously or the similar drawing which we made some time ago. Indeed, you will see, if you consider the complex conditions under which our inner experience arises, that nothing like the same degree of similarity between the earlier and the later product can be expected here as may be found under certain circumstances in the field of external actions like writing and drawing. The circumstance that new processes exhibit relations and similarity to others previously existing can no more prove the continued existence of the idea as such than it can be inferred from the similarity of the movement of the pen in writing a definite word now to that involved on a former occasion, that this movement has continued to exist in an invisible form from the time it was first made, and has simply become visible again when we have written the word anew.—WUNDT *Psychology*, lect. 16, p. 236. (Son. & Co., 1896.)

1548. IDENTIFICATION OFTEN FALLACIOUS—*Witness Sees the Expected—Forms Recognized in "Materializing Séances."*—Testimony to personal identity is proverbially fallacious for similar reasons [viz.: illusion through preconception]. A man has witnessed a rapid crime or accident, and carries away his mental image. Later he is confronted by a prisoner whom he forthwith perceives in the light of that image, and recognizes, or "identifies," as a participant, altho he may never have been near the spot. Similarly at the so-called "materializing séances" which fraudulent mediums give: in a dark room a man sees a gauze-robed figure who in a whisper tells him she is the spirit of his sister, mother, wife, or child, and falls upon his neck. The darkness, the previous forms, and the expectancy have so filled his mind with premonitory images that it is no wonder he perceives what is suggested. These fraudulent "séances" would furnish most precious documents to the psychology of perception, if they could only be satisfactorily inquired into.—JAMES *Psychology*, vol. ii, ch. 19, p. 97. (H. H. & Co., 1899.)

1549. IDIOCY A MANUFACTURED ARTICLE—*Recompense of Violated Law—Intemperance a Fruitful Cause of Imbecility.*—The congenital idiot is deprived of his human birthright; for he is born with such a defect of brain that he cannot display any or can only display very feeble and imperfect mental functions. From no fault of his own is he thus afflicted, seeing that he must be held innocent of all offense but the offense of his share of original sin; but it is nowise so clear that it is not from some fault of his parents. It is all too true that in many cases there has observably been a neglect or disregard of the laws which govern the progress of human development through the ages. Idiocy is indeed a manufactured article; and altho we are not always able to tell how it is manufactured, still its important causes are known and are within control. Many cases are distinctly traceable to parental intemperance and excess. Out of 300 idiots in Massachusetts, Dr. Howe found as many as 145 to be the offspring of intemperate parents; and there are numerous scattered observations which prove that chronic alcoholism in the parent may directly occasion idiocy in the child. [See ALCOHOL and HEREDITY.] I think, too, that there is no reasonable question of the ill-effects of marriages of consanguinity; that their tendency is to produce degeneracy of the race, and idiocy as the extremest form of such degeneracy.—MAUDSLEY *Body and Mind*, lect. 2, p. 44. (A., 1898.)

1550. IGNORANCE, CONSCIOUS, A STEP TOWARD KNOWLEDGE—It [Professor Lockyer's theory of dissociation of chemical elements] brings us face to face with the mysteries of the ultimate constitution of matter, and of its relations to the vibrating medium filling space. It makes our ignorance on these subjects seem at once more dense and more definite. Nevertheless, this in itself (tho the saying appears paradoxical) constitutes an advance. Unfelt ignorance persists. Ignorance that is stricken with uneasy self-consciousness is already on the way to be turned into knowledge.—CLERKE *History of Astronomy*, pt. ii, ch. 4, p. 261. (Bl., 1893.)

1551. IGNORANCE, HUMAN, IMAGINES CAPRICE IN NATURE—The flowers of orchids, in their strange and endless diversity of shape, may be compared with the great vertebrate class of fish, or still more appropriately with tropical homopterous insects, which appear to us as if they had been modeled in the wildest caprice, but this no doubt is due to our ignorance of their requirements and conditions of life.—DARWIN *Fertilization of Orchids*, ch. 7, p. 224. (A., 1898.)

1552. IGNORANCE NOT THE MOTHER OF THE SUBLIME—*Science Exalts to a Truer Sublimity—The Facts of Astronomy Surpass All Poetic Ideals.*—Writers who know nothing of the true poetry of modern science have supposed that the perception of the sublime is born of ignorance, and that to admire it is necessary not to know. This is assuredly a strange error, and the best proof of it is found in the captivating charm and the passionate admiration which divine science now inspires, not in some rare minds only, but in thousands of intellects, in a hundred thousand readers impassioned in the search for truth, surprised, almost ashamed, at having lived in ignorance of and indifference to these splendid realities, anxious to incessantly enlarge their conception of things eternal, and feeling admiration increasing in their dazzled minds in proportion as they penetrate farther into infinitude. What was the universe of Moses of Job, of Hesiod, or of Cicero, compared to ours! Search through all the religious mysteries, in all the surprises of art, painting music, the theater, or romance; search for an intellectual contemplation which produces in the mind the impression of truth of grandeur, of the sublime, like astronomical contemplation!—FLAMMARION *Popular Astronomy*, bk. vi, ch. 1, p. 554. (A.)

1553. IGNORANCE OF MAN AS TO RELATIONS OF ORGANIC LIFE—*Alleviations of Struggle for Life.*—It is good thus to try in imagination to give any one species an advantage over another. Probably in no single instance should we know what to do. This ought to convince us of our ignorance on the mutual relations of all organic beings, a conviction as necessary as it is difficult to acquire. All that we can do is to keep steadily in mind that each organic being is striving to increase in a geometrical ratio; that each, at some period of its life, during some season of the year, during each generation, or at intervals, has to struggle for life and to suffer great destruction. When we reflect on this struggle we may console ourselves with the full belief that the war of Nature is not incessant, that no fear is felt, that death is generally prompt, and that the vigorous, the healthy, and the happy survive and multiply.—DARWIN *Origin of Species*, ch. 3, p. 72. (Burt.)

1554. IGNORANCE OF NATURAL LAWS—*Air Not To Be Navigated by Buoyancy.*—On the earth and on the sea man has attained to powers of locomotion with which in strength, endurance, and in velocity, no animal movement can compare. But the air is an element on which he cannot travel—an ocean which he cannot navigate. The birds of heaven are still his envy, and on the paths they tread he cannot follow. As yet! for it is not certain that this exclusion is to be perpetual. His failure has resulted quite as much from his ignorance of natural laws as from his inability to meet the conditions which they demand. All attempts to guide bodies buoyant in the air must be fruitless. Balloons are mere toys. No

flying animal has ever been formed on the principle of buoyancy. Birds and bats and dragons have been all immensely heavier than the air, and their weight is one of the forces most essential to their flight. Yet there is a real impediment in the way of man navigating the air—and that is the excessive weight of the only great mechanical moving powers hitherto placed at his disposal. When science shall have discovered some moving power greatly lighter than any we yet know, in all probability the problem will be solved. But of one thing we may be sure—that if man is ever destined to navigate the air it will be in machines formed in strict obedience to the mechanical laws which have been employed by the Creator for the same purpose in flying animals.—ARGYLL *Reign of Law*, ch. 3, p. 101. (Burt.)

1555. ILLUMINATION OF OCEAN BY PHOSPHORESCENT ANIMALS—To give an example of the extent to which the illumination due to phosphorescent organisms may reach, I may quote a passage from the writings of the late Sir Wyville Thomson:

"After leaving the Cape Verde Islands the sea was a perfect blaze of phosphorescence. There was no moon, and altho the night was perfectly clear and the stars shone brightly, the luster of the heavens was fairly eclipsed by that of the sea. It was easy to read the smallest print, sitting at the after-port in my cabin, and the bows shed on either side rapidly widening wedges of radiance so vivid as to throw the sails and rigging into distinct lights and shadows."—HICKSON *Fauna of the Deep Sea*, ch. 2, p. 26. (A., 1894.)

1556. ILLUSION AT SEA—*Empty Cap and Coat Assume Guise of Engineer.*—I was lying in my berth in a steamer listening to the sailors holystone the deck outside, when, on turning my eyes to the window, I perceived with perfect distinctness that the chief engineer of the vessel had entered my stateroom, and was standing looking through the window at the men at work upon the guards. Surprised at his intrusion, and also at his intentness and immobility, I remained watching him and wondering how long he would stand thus. At last I spoke; but getting no reply sat up in my berth, and then saw that what I had taken for the engineer was my own cap and coat hanging on a peg beside the window. The illusion was complete; the engineer was a peculiar-looking man, and I saw him unmistakably; but after the illusion had vanished I found it hard voluntarily to make the cap and coat look like him at all.—JAMES *Psychology*, vol. ii, ch. 19, p. 101. (H. H. & Co., 1899.)

1557. ILLUSION DUE TO RELATIVE SENSATIONS—*Opposites, as Heat and Cold, Combine in a Contradiction.*—Another striking example is that of our sense of the temperature of objects, which is known to be strictly relative to a previous sensation, or more correctly to the momentary condition of the organ. Yet, tho every intelligent person knows this, the deeply rooted habit of making sensation the measure of objective quality asserts its sway, and frequently leads us into illusion. The well-known experiment of first plunging one hand in cold water, the other in hot, and then dipping them both in tepid, is a startling example of this organized tendency. For here we are strongly disposed to accept the palpable contradiction that the same water is at once warm and cool.—SULLY *Illusions*, ch. 4, p. 65. (A., 1897.)

1558. ILLUSION OF ABSENCE OF LIFE—*Earth at Few Miles' Distance Seems a Dead World.*—When [astronomers] declare that the moon is uninhabited because they see nothing moving, they are singularly deceived in the value of telescopic testimony. At some miles high in a balloon, with a clear sky and beautiful sunshine, we distinguish with the naked eye towns, woods, fields, meadows, rivers, roads; but we see nothing moving, and the impression felt directly (I have often experienced it in my aerial voyages) is of silence, solitude, and the absence of life. Living beings are no longer visible, and if we did not know that there are harvest-men in the fields, flocks in the meadows, birds in the woods, fish in the waters, there is nothing to make us realize their existence. If, then, the earth seems like a dead world when seen from only a few miles' distance, what is it but illusion to assert that the moon is truly a dead world, because we view it at 120 miles or more? for it is only exceptionally that we can use the highest magnifying powers, and in general we do not apply to the observation of the moon powers exceeding a thousand. What, then, can we see of life at such a distance? Assuredly nothing, for forests, plants, cities, all would disappear.—FLAMMARION *Popular Astronomy*, bk. ii, ch. 6, p. 148. (A.)

1559. ILLUSION OF MOVEMENT—*Stationary Train Thought To Be in Motion—Sensation Due to Mental Inference.*—There is an illusion of movement of the opposite sort with which every one is familiar at railway stations. Habitually, when we ourselves move forward, our entire field of view glides backward over our retina. When our movement is due to that of the windowed carriage, car, or boat in which we sit, all stationary objects visible through the window give us a sensation of gliding in the opposite direction. Hence, whenever we get this sensation, of a window with all objects visible through it moving in one direction, we react upon it in our customary way, and perceive a stationary field of view, over which the window, and we ourselves inside of it, are passing by a motion of our own. Consequently when another train comes alongside of ours in a station, and fills the

entire window, and, after standing still awhile, begins to glide away, we judge that it is our train which is moving, and that the other train is still. If, however, we catch a glimpse of any part of the station through the windows, or between the cars of the other train, the illusion of our own movement instantly disappears, and we perceive the other train to be the one in motion. This, again, is but making the usual and probable inference from our sensation.—JAMES *Psychology*, vol. ii, ch. 19, p. 90. (H. H. & Co., 1899.)

1560. ILLUSION OF PERCEPTION—*A Mother's Needless Terror—The Seeing of Complementary Colors.*—The eye also under some circumstances may lose its sensibility for particular colors, or be thrown into such an unusual state as to present all objects to the mind under the appearance of a false color. Thus, if a person looks fixedly for a time at a bright red object and then turns his eye to a white wall, he will perceive a green image of the red object depicted on the white surface. A lady of our acquaintance was once thrown into an alarming but laughable paroxysm of terror by an effect of this kind. She had been for some hours attentively sewing on a bright crimson dress, when her attention was directed towards her child, who in its sport had thrown itself on the carpet; its face appeared of the most ghastly hue, and the affrighted mother screamed in agony that her child was in convulsions; the other inmates of the house hastened to her assistance, but they were surprised to find the little one smiling in perfect health. The sanity of the mother became the natural object of solicitude until the effect was properly referred to the impression made on her eye by the crimson cloth.—HENRY *Color-Blindness, Scientific Writings*, vol. i, p. 234. (Sm. Inst., 1886.)

1561. ILLUSION THE LOT OF ALL MEN—*Absolute Truth Sought in Vain.*—Notwithstanding the flattering supposition of common sense, that illusion is essentially an incident in abnormal life, the careful observer knows well enough that the case is far otherwise. There is, indeed, a view of our race diametrically opposed to the flattering opinion referred to above, namely, the humiliating judgment that all men habitually err, or that illusion is to be regarded as the natural condition of mortals. This idea has found expression not only in the cynical exclamation of the misanthropist that most men are fools, but also in the cry of despair that sometimes breaks from the weary searcher after absolute truth, and from the poet when impressed with the unreality of his early ideals.—SULLY *Illusions*, ch. 1, p. 2. (A., 1897.)

1562. ILLUSION THROUGH MENTAL SUGGESTION—The following, related by Dr. Tuke, shows in an admirable manner how similar impressions may be revived, and falsify the perceptions of a number of persons:

"During the conflagration at the Crystal Palace, in the winter of 1866-67, when the animals were destroyed by the fire, it was supposed that the chimpanzee had succeeded in escaping from its cage. Attracted to the roof with the expectation in full force, men saw the unhappy animal holding on to it and writhing in agony to get astride one of the iron ribs. It need not be said that its struggles were watched by those below with breathless suspense, and, as the newspapers informed us, 'with sickening dread.' But there was no animal whatever there; and all this feeling was thrown away upon a tattered piece of blind, so torn as to resemble to the eye of fancy the body, arms, and legs of an ape!"—ELDRIDGE-GREEN *Memory and Its Cultivation*, pt. i, ch. 7, p. 172. (A., 1900.)

1563. ILLUSION THROUGH PRECONCEPTION—*Seeing the Expected.*—We [sometimes] perceive a wrong object because our mind is full of the thought of it at the time, and any sensation which is in the least degree connected with it touches off, as it were, a train already laid, and gives us a sense that the object is really before us. Here is a familiar example:

"If a sportsman, while shooting woodcock in cover, sees a bird about the size and color of a woodcock get up and fly through the foliage, not having time to see more than that it is a bird of such a size and color, he immediately supplies by inference the other qualities of a woodcock, and is afterwards disgusted to find that he has shot a thrush. I have done so myself, and could hardly believe that the thrush was the bird I had fired at, so complete was my mental supplement to my visual perception."

As with game, so with enemies, ghosts, and the like. Any one waiting in a dark place and expecting or fearing strongly a certain object, will interpret any abrupt sensation to mean that object's presence. The boy playing "I spy," the criminal skulking from his pursuers, the superstitious person hurrying through the woods or past the churchyard at midnight, the man lost in the woods, the girl who tremulously has made an evening appointment with her swain, all are subject to illusions of sight and sound which make their hearts beat till they are dispelled.—JAMES *Psychology*, vol. ii, ch. 19, p. 95. (H. H. & Co., 1899.)

1564. ILLUSIONS IN NATURE—*The Specter of the Brocken.*—There is a wonderful exhibition of shadow to be seen under certain conditions of the atmosphere on one of the peaks of the Hartz Mountains, called the Brocken. If one or more people stand on the summit at sunrise they can see an enlarged shadow of themselves as well as the top of the mountain, together with a house with a tower on it, standing out against the sky in enormous proportions; the clouds and mist form a screen to catch the shadows, and, while it is as easily ex-

plained as the shadow of a tree in the summer sunshine, it has an uncanny appearance. It is called the "Specter of the Brocken," and has been looked upon with superstitious awe by the ignorant people for ages past. This specter may be seen both at sunrise and at sunset, but of course on opposite sides of the mountain.—ELISHA GRAY *Nature's Miracles*, vol. ii, ch. 27, p. 215. (F. H. & H., 1900.)

1565. ILLUSIONS OF SIGHT—*Spectrum Seen in Darkness—Newton's Experience.*—Sir Isaac Newton was able to recall [the spectrum] by going into the dark and directing his mind intensely, "as when a man looks earnestly to see a thing which is difficult to be seen," and this [image], after a frequent repetition of this process, came (he says) to return "as often as I began to meditate on the phenomena, even tho I lay in bed at midnight with my curtains drawn." For altho phenomena of this class are often regarded as ocular spectra produced by retinal change, their reproduction by mental states seems to place them in the same category as the visual sensations which are distinctly reproduced by memory—that is, by cerebral change. In fact, there is such a gradational transition from the one state to another that it seems clear that they have a common origin.—CARPENTER *Mental Physiology*, bk. i, ch. 4, p. 165. (A., 1900.)

1566. ILLUSIONS OF TOUCH—*False Interpretation of True Perception.*—The different degrees of sensitiveness possessed by different parts may give rise to errors of judgment in estimating the distance between two points where the skin is touched. Thus, if blunted points of a pair of compasses (maintained at a constant distance apart) be slowly drawn over the skin of the cheek toward the lips, it is almost impossible to resist the conclusion that the distance between the points is gradually increasing. When they reach the lips they seem to be considerably further apart than on the cheek. Thus, too, our estimate of the size of a cavity in a tooth is usually exaggerated when based upon sensation derived from the tongue alone. Another curious illusion may here be mentioned. If we close the eyes, and place a small marble or pea between the crossed fore and middle fingers, we seem to be touching two marbles. This illusion is due to an error of judgment. The marble is touched by two surfaces which, under ordinary circumstances, could only be touched by two separate marbles, hence the mind, taking no cognizance of the fact that the fingers are crossed, forms the conclusion that two sensations are due to two marbles.—BAKER *Handbook of Physiology*, vol. ii, ch. 19, p. 165. (W. W., 1885.)

1567. ILLUSIONS USED IN HEATHEN RITES—*Images of Gods Formed by Concave Mirrors.*—A stick half immersed in water always looks broken, however well we may know that the appearance is due to the bending of the rays of light. Similarly, an echo always sounds as tho it came from some object in the direction in which the air-waves finally travel to the ear, tho we are perfectly sure that these undulations have taken a circuitous course. It is hardly necessary to remind the reader that the deeply organized tendency to mistake the direction of the visible or audible object in these cases has from remote ages been made use of as a means of popular delusion. Thus, we are told by Sir D. Brewster, in his entertaining "Letters on Natural Magic" (letter iv), that the concave mirror was probably used as the instrument for bringing the gods before the people. The throwing of the images formed by such mirrors upon smoke or against fire, so as to make them more distinct, seems to have been a favorite device in the ancient art of necromancy.—SULLY *Illusions*, ch. 5, p. 73. (A., 1897.)

1568. IMAGES OF MEMORY MAY HAVE A KIND OF OBJECTIVE PRESENT EXISTENCE—It is only when the sting of the recollection is removed, when, for example, the calling-up of the image of a lost friend is no longer accompanied with the bitterness of futile longing, that a healthy mind ventures to nourish recollections of such remote events and to view these as part of its recent experiences. In this case the mnemonic image becomes transformed into a kind of present emotional possession, an element of that idealized and sublimated portion of our experience with which all imaginative persons fill up the emptiness of their actual lives, and to which the poet is wont to give an objective embodiment in his verse.—SULLY *Illusions*, ch. 10, p. 261. (A., 1897.)

1569. IMAGINATION, CREATIVE—*Mozart's Composing.*—Mozart describes thus his manner of composing: First, bits and crums of the piece come and gradually join together in his mind; then, the soul getting warmed to the work, the thing grows more and more, "and I spread it out broader and clearer, and at last it gets almost finished in my head, even when it is a long piece, so that I can see the whole of it at a single glance in my mind, as if it were a beautiful painting or a handsome human being; in which way I do not hear it in my imagination at all as a succession—the way it must come later—but all at once, as it were. It is a rare feast! All the inventing and making goes on in me as in a beautiful strong dream. But the best of all is the hearing of it all at once."—JAMES *Psychology*, vol. i, ch. 9, p. 255. (H. H. & Co., 1899.)

1570. IMAGINATION DISTORTING FACT—*Seaman's Strange Tale—Scientific Basis of Story.*—Another animal, a zoophyte, consists of a thin, straight, fleshy stem,

with alternate rows of polypi on each side, and surrounding an elastic stony axis, varying in length from eight inches to two feet. The stem at one extremity is truncate, but at the other is terminated by a vermiform fleshy appendage. . . . At low water hundreds of these zoophytes might be seen, projecting like stubble, with the truncate end upwards, a few inches above the surface of the muddy sand. When touched or pulled they suddenly drew themselves in with force, so as nearly or quite to disappear. . . . It is always interesting to discover the foundation of the strange tales of the old voyagers; and I have no doubt but that the habits of this *Virgularia* explain one such case. Captain Lancaster, in his voyage in 1601, narrates that on the sea-sands of the Island of Sombrero, in the East Indies, he "found a small twig growing up like a young tree, and on offering to pluck it up it shrinks down to the ground, and sinks, unless held very hard. On being plucked up, a great worm is found to be its root, and as the tree groweth in greatness, so doth the worm diminish; and as soon as the worm is entirely turned into a tree it rooteth in the earth, and so becomes great. This transformation is one of the strangest wonders that I saw in all my travels: for if this tree is plucked up while young, and the leaves and bark stripped off, it becomes a hard stone when dry, much like white coral: thus is this worm twice transformed into different natures. Of these we gathered and brought home many."—DARWIN *Naturalist's Voyage around the World*, ch. 5, p. 99. (A., 1898.)

1571. IMAGINATION ELIMINATED— *Photography vs. Drawing—The Artist Has More Discretion—The Camera More Absolute Faithfulness—Conflict of Testimony between Conscientious Observers.*—The skilful draftsman can show in the same picture details differing to any extent in intensity, while the photograph is, so to speak, limited to the reproduction of only one certain class of details at a time. Still we can always be sure that whatever a photograph does show is an autographic representation of fact, and not a figment of the imagination. This is not the case with drawings; for it is remarkable how widely two conscientious artists will differ in their representations of the same object, seen by both with the same telescope, and under the same circumstances. As an accurate record of the number, position, and magnitude of the solar spots at any given time, the photograph is, of course, unexceptionable.—YOUNG *The Sun*, ch. 2, p. 51. (A., 1898.)

1572. IMAGINATION ESSENTIAL TO SCIENTIFIC RESEARCH—An intellectual and ideal combination of the facts already established often guides almost imperceptibly the course of presage, elevating it as by a power of inspiration. How much has been enounced among the Indians and Greeks and during the Middle Ages, regarding the connection of natural phenomena, which, at first either vague or blended with the most unfounded hypotheses, has, at a subsequent epoch, been confirmed by sure experience and then been recognized as a scientific truth! The presentient fancy and the vivid activity of spirit which animated Plato, Columbus, and Kepler must not be disregarded, as if they had effected nothing in the domain of science, or as if they tended, of necessity, to draw the mind from the investigation of the actual.—HUMBOLDT *Cosmos*, vol. ii, pt. ii, p. 107. (H., 1897.)

1573. IMAGINATION IMPORTS FALSE MATERIAL INTO SCENES OF MEMORY— Not only does our idea of the past become inexact by the mere decay and disappearance of essential features: it becomes positively incorrect through the gradual incorporation of elements that do not properly belong to it. Sometimes it is easy to see how these extraneous ideas get imported into our mental representation of a past event. Suppose, for example, that a man has lost a valuable scarf-pin. His wife suggests that a particular servant, whose reputation does not stand too high, has stolen it. When he afterwards recalls the loss, the chances are that he will confuse the fact with the conjecture attached to it, and say he remembers that this particular servant did steal the pin. Thus, the past activity of imagination serves to corrupt and partially falsify recollections that have a genuine basis of fact.—SULLY *Illusions*, ch. 10, p. 264. (A., 1897.)

1574. IMAGINATION IN SCIENCE— *A Constructive Power—Ideas of Cause, Gravitation, Atomic Theory, and Kepler's Laws, Its Products.*—With accurate experiment and observation to work upon, imagination becomes the architect of physical theory. Newton's passage from a falling apple to a falling moon was an act of the prepared imagination, without which the "laws of Kepler" could never have been traced to their foundations. Out of the facts of chemistry the constructive imagination of Dalton formed the atomic theory. Davy was richly endowed with the imaginative faculty, while with Faraday its exercise was incessant, preceding, accompanying, and guiding all his experiments. His strength and fertility as a discoverer are to be referred in great part to the stimulus of his imagination. Scientific men fight shy of the word because of its ultrascientific connotations; but the fact is that without the exercise of this power our knowledge of Nature would be a mere tabulation of coexistences and sequences. We should still believe in the succession of day and night, of summer and winter; but the conception of force would vanish from our universe; causal relations would disappear, and with them that science which is now binding the

parts of Nature into an organic whole.—TYNDALL *Fragments of Science*, vol. ii, ch. 8, p. 104. (A., 1897.)

1575. ——— ——— *Checks of Reason and Observation.*—Imagination is necessary to the man of science, and we could not reason on our present subject without the power of presenting mentally a picture of the earth's crust cracked and fissured by the forces which produced its upheaval. Imagination, however, must be strictly checked by reason and by observation.—TYNDALL *Hours of Exercise in the Alps*, ch. 20, p. 230. (A., 1898.)

1576. ——— ——— *Mythology Suggests Botanical Names.*—Linnæus gave the name *Andromeda* after the Ethiopian maid whose mother's over-great boasts of the daughter's beauty made her the victim of Poseidon's wrath. Linnæus justified his procedure by a remarkable play of fancy: "This most choice and beautiful virgin gracefully erects her long and shining neck (the peduncle), her face with its rosy lips (the corolla) far excelling the best pigment. She kneels on the ground with her feet bound (the lower part of the stem incumbent), surrounded with water, and fixed to a rock (a projecting clod), exposed to frightful dragons (frogs and newts). She bends her sorrowful face (the flower) towards the earth, stretches up her innocent arms (the branches) toward heaven, worthy of a better place and happier fate, until the welcome Perseus (summer), after conquering the monster, draws her out of the water and renders her a fruitful mother, when she raises her head (the fruit) erect."—GILL *Address before the Amer. Assoc. for the Advancement of Science, Smithsonian Report for 1896*, pp. 457-83.

1577. ——— ——— *Producing Effects in the World of Fact.*—This conception of physical theory [of light] implies, as you perceive, the exercise of the imagination. Do not be afraid of this word, which seems to render so many respectable people, both in the ranks of science and out of them, uncomfortable. That men in the ranks of science should feel thus is, I think, a proof that they have suffered themselves to be misled by the popular definition of a great faculty instead of observing its operation in their own minds. Without imagination we cannot take a step beyond the bourn of the mere animal world, perhaps not even to the edge of this one. But, in speaking thus of imagination, I do not mean a riotous power which deals capriciously with facts, but a well-ordered and disciplined power, whose sole function is to form conceptions which the intellect imperatively demands. Imagination, thus exercised, never really severs itself from the world of fact. This is the storehouse from which the materials for all its pictures are derived; and the magic of its art consists, not in creating things anew, but in so changing the magnitude, position, and other relations of sensible things as to render them fit for the requirements of the intellect in the subsensible world.—TYNDALL *Lectures on Light*, lect. 2, p. 43. (A., 1898.)

1578. IMAGINATION MAY MAKE IDEAL WORLD ALMOST REAL—The higher feelings or emotions are distinguished from the simple sense-feelings in being largely representative. Thus, a feeling of contentment at any moment, tho no doubt conditioned by the bodily state and the character of the organic sensations, or cœnesthesis, commonly depends for the most part on intellectual representations of external circumstances or relations, and may be called an ideal foretaste of actual satisfactions, such as the pleasures of success, of companionship, and so on. This being so, it is easy for imagination to call up a semblance of these higher feelings. Since they depend largely on representation, a mere act of representation may suffice to excite a degree of the feeling hardly distinguishable from the actual one. Thus, to imagine myself as contented is really to see myself at the moment as actually contented. Again, the actor, tho . . . he does not feel all that the spectator is apt to attribute to him, tends, when vividly representing to himself a particular shade of feeling, to regard himself as actually feeling in this way. Thus, it is said of Garrick, that when acting Richard III, he felt himself for the moment to be a villain.—SULLY *Illusions*, ch. 8, p. 199. (A., 1897.)

1579. IMAGINATION, POETIC, OF GREAT DISCOVERER — *Scientific Insight Penetrates the Unknown—Columbus Infers a Continent—Orinoco Thought a River of Paradise*—The appearance of this region [near the mouth of the Orinoco] first convinced the bold navigator Columbus of the existence of an American continent. "Such an enormous body of fresh water," concluded this acute observer of Nature, "could only be collected from a river having a long course; the land, therefore, which supplied it must be a continent and not an island." As, according to Arrian, the companions of Alexander, when they penetrated across the snow-crowned summits of Paropamisus, believed that they recognized in the crocodile-teeming Indus a part of the Nile, so Columbus, in his ignorance of the similarity of physiognomy which characterizes all the products of the climate of palms, imagined that the new continent was the eastern coast of the far-projecting Asia. The grateful coolness of the evening air, the ethereal purity of the starry firmament, the balmy fragrance of flowers, wafted to him by the land breeze—all led him to suppose (as we are told by Herrera, in the "Decades") that he was approaching the Garden of Eden, the sacred abode of our first parents. The Orinoco seemed to him one of the four rivers which, according to the venerable tradition of the ancient world, flowed from Paradise to water and divide the surface of the earth,

newly adorned with plants. This poetical passage in the Journal of Columbus, or rather in a letter to Ferdinand and Isabella, written from Haiti in October, 1498, presents a peculiar psychological interest. It teaches us anew that the creative fancy of the poet manifests itself in the discoverer of a world no less than in every other form of human greatness.—HUMBOLDT *Views of Nature*, p. 155. (Bell, 1896.)

1580. IMAGINATION PRODUCING FAINTNESS—"A clergyman told me that some time ago suspicions were entertained in his parish of a woman who was supposed to have poisoned her newly-born infant. The coffin was exhumed, and the procurator-fiscal, who attended with the medical men to examine the body, declared that he already perceived the odor of decomposition, which made him feel faint, and in consequence he withdrew. But on opening the coffin it was found to be empty, and it was afterwards ascertained that no child had been born, and consequently no murder committed."—BENNET quoted by CARPENTER in *Nature and Man*, bk. i, ch. 4, p. 158. (A., 1900.)

1581. IMAGINATION STIMULATED BY STUDY OF NATURE—*Sublimity of a Tropical Night.*—If I might be allowed to abandon myself to the recollections of my own distant travels I would instance, among the most striking scenes of Nature, the calm sublimity of a tropical night when the stars, not sparkling as in our northern skies, shed their soft and planetary light over the gently heaving ocean, or I would recall the deep valleys of the Cordilleras, where the tall and slender palms pierce the leafy veil around them, and waving on high their feathery and arrow-like branches, form, as it were, "a forest above a forest"; or I would describe the summit of the peak of Teneriffe when a horizontal layer of clouds, dazzling in whiteness, has separated the cone of cinders from the plain below, and suddenly the ascending current pierces the cloudy veil, so that the eye of the traveler may range from the brink of the crater, along the vine-clad slopes of Orotava, to the orange-gardens and banana-groves that skirt the shore. In scenes like these it is not the peaceful charm uniformly spread over the face of Nature that moves the heart, but rather the peculiar physiognomy and conformation of the land, the features of the landscape, the ever-varying outline of the clouds, and their blending with the horizon of the sea, whether it lies spread before us like a smooth and shining mirror or is dimly seen through the morning mist. All that the senses can but imperfectly comprehend, all that is most awful in such romantic scenes of Nature, may become a source of enjoyment to man, by opening a wide field to the creative powers of his imagination. Impressions change with the varying movements of the mind, and we are led by a happy illusion to believe that we receive from the external world that with which we have ourselves invested it.—HUMBOLDT *Cosmos*, vol. i, int., p. 26. (H., 1897.)

1582. IMITATION A CONTROLLING HUMAN IMPULSE—*Civilization Founded upon It.*—The instinct of imitating gestures develops earlier than that of imitating sounds [and] usually falls well inside the limits of the first year. Later come all the various imitative games in which childhood revels, playing "horse," "soldiers," etc., etc. And from this time onward man is essentially the imitative animal. His whole educability and in fact the whole history of civilization depend on this trait, which his strong tendencies to rivalry, jealousy, and acquisitiveness reenforce. "*Humani nihil a me alienum puto*" is the motto of each individual of the species, and makes him, whenever another individual shows a power or superiority of any kind, restless until he can exhibit it himself. . . . And there is the imitative tendency which shows itself in large masses of men, and produces panics and orgies and frenzies of violence, and which only the rarest individuals can actively withstand. This sort of imitativeness is possessed by man in common with other gregarious animals, and is an instinct in the fullest sense of the term, being a blind impulse to act as soon as a certain perception occurs. It is particularly hard not to imitate gaping, laughing, or looking and running in a certain direction if we see others doing so. Certain mesmerized subjects must automatically imitate whatever motion their operator makes before their eyes. A successful piece of mimicry gives to both bystanders and mimic a peculiar kind of esthetic pleasure.—JAMES *Psychology*, vol. ii, ch. 24, p. 408. (H. H. & Co., 1899.)

1583. IMITATION INSTINCTIVE AND UNIVERSAL—*The Chief Element in the Learning of Language.*—From the first days of life we are surrounded by our fellow men and imitate their actions. And these mimetic movements are instinctive in character. As soon as the child's consciousness is aroused from its first sleepy passivity, it begins to perceive the expressions of others' emotions, and to respond to them by similar emotions with corresponding impulses. The continued imitation by which a child comes to learn the language that is spoken round it is impulsive, not voluntary.—WUNDT *Psychology*, lect. 27, § 1, p. 396. (Son. & Co., 1896.)

1584. IMITATION SECURES THE CONTINUITY OF RACIAL LIFE—*Social Heredity.*—Man has always been recognized as the imitative animal *par excellence*. And there is hardly a book on psychology, however old, which has not devoted at least one paragraph to this fact. . . . Each of us is in fact what he is almost exclusively

by virtue of his imitativeness. We become conscious of what we ourselves are by imitating others—the consciousness of what the others are precedes—the sense of self grows by the sense of pattern. The entire accumulated wealth of mankind—languages, arts, institutions, and sciences—is passed on from one generation to another by what Baldwin has called social heredity, each generation simply imitating the last. . . . Invention, using the term most broadly, and imitation are the two legs, so to call them, on which the human race historically has walked.—JAMES *Talks to Teachers*, ch. 7, p. 48. (H. H. & Co., 1900.)

1585. IMMIGRATION OF ANIMALS FROM SHALLOW WATER TO THE DEEP SEA—*Gradual Adaptation to Their New Home.*—Nor can we consider for a moment that the abyss was the original source of the shallow-water fauna; for not only do we find but few types that can be considered to be, in any sense of the word, ancestral in character, but on the contrary most of the animals of the deep sea seem to be specially modified types of shallow-water forms. The most probable explanation of the origin of the deep-sea fauna is the one that was put forward by Moseley and has been since supported by almost every authority on the subject, namely, that the fauna of the deep sea has been derived from successive immigrations of the animals from the shallow water.—HICKSON *Fauna of the Deep Sea*, ch. 3, p. 54. (A., 1894.)

1586. IMMORTALITY OF GRATEFUL REMEMBRANCE A SHAM—*Delusion of Positivism.*—The positivist argument that the only worthy immortality is survival in the grateful remembrance of one's fellow creatures would hardly be regarded as anything but a travesty and trick. If the world's long-cherished beliefs are to fall, in God's name let them fall, but save us from the intellectual hypocrisy that goes about pretending we are none the poorer!—FISKE *Through Nature to God*, pt. iii, ch. 5, p. 170. (H. M. & Co., 1900.)

1587. IMMORTALITY, RACIAL, A DELUSIVE HOPE—*The Moon a Dead World—Perhaps a Cemetery.*—The moon, then, is dead; and if it ever was the home of a race like ours that race is dead, too. I have said that our New Astronomy modifies our view of the moral universe as well as of the physical one; nor do we need a more pregnant instance than in this before us. In these days of decay of old creeds of the eternal, it has been sought to satisfy man's yearning toward it by founding a new religion whose god is humanity, and whose hope lies in the future existence of our own race, in whose collective being the individual who must die may fancy his aims and purpose perpetuated in an endless progress. But, alas for hopes looking to this alone! we are here brought to face the solemn thought that, like the individual, tho at a little further date, humanity itself may die!—LANGLEY *New Astronomy*, ch. 5, p. 171. (H. M. & Co., 1896.)

1588. IMMUNITY, NATURAL, OF SOME PERSONS AND RACES—*Relative Immunity of Children and Adults—Plague and Leprosy Rare in English Race.*—The term "natural immunity" is used to denote natural resistance to some particular specific disease. It may refer to race, or age, or individual idiosyncrasies. We not infrequently meet with examples of this freedom from disease. Certain races of men do not, as a rule, take certain diseases. For example, plague and leprosy, tho epidemic in some countries, fail to get a footing in England. This, of course, is due in great measure to the sanitary organization and cleanly customs of the English people. Still, it is also due to the fact that the English appear in some degree to be immune. Some authorities hold that the immunity against leprosy is due to the fact that the disease has exhausted itself in the English race. However that may be, we know that immunity, entire or partial, exists. Children, again, are susceptible to certain diseases and insusceptible to certain others to which older people are susceptible. We know, too, that some individuals have a marked protection against some diseases. Some people coming into the way of infection at once fall victims to the disease, whilst others appear to be proof against it.—NEWMAN *Bacteria*, ch. 7, p. 240. (G. P. P., 1899.)

1589. IMPERFECTION OF HUMAN SENSES—*Dependence on Speed of Light—Only the Past of the Stars Known—And That in Fragments—Gravity Would Be a Swifter Messenger.*—We learn by a view of the heavens that twenty years ago Sirius was shining with such and such brightness; that a hundred years ago some other star was shining with its degree of luster, and so on; but the star depths are never revealed to us exactly as they are at the moment, or exactly as they were at any moment. Yet this is merely due to the imperfection of our senses. We judge by the light of these objects, and this light travels at such and such a rate. It is conceivable that creatures might have a sense enabling them to judge by some other form of action, exerted by the stars, as for instance by the action of gravity. If gravity were the action thus effective, the information conveyed respecting the universe would be far more nearly contemporaneous, since the action of gravity certainly travels many thousands of times faster than light, even if it do not travel with infinite velocity as some philosophers suppose.—PROCTOR *Expanse of Heaven*, p. 207. (L. G. & Co., 1897.)

1590. IMPERFECTION OF INSTRUMENTS—*Diffusion of Light Weakens Optical Image in Giant Telescope—Atmospheric Hindrances.*—Lord Rosse's telescope possesses a nominal power of 6,000—that is,

it shows the moon as if viewed with the naked eye at a distance of forty miles. But this seeming advantage is neutralized by the weakening of the available light through excessive diffusion, as well as by the troubles of the surging sea of air through which the observation must necessarily be made. Professor Newcomb, in fact, doubts whether with *any* telescope our satellite has ever been seen to such advantage as it would be if brought within 500 miles of the unarmed eye.—CLERKE *History of Astronomy*, pt. i, ch. 6, p. 148. (Bl., 1893.)

1591. IMPERFECTION OF THE GEOLOGICAL RECORD—*Destructive Agencies Obliterate the Remains.*—It can be demonstrated that the geological record must be incomplete, that it can only preserve remains found in certain favorable localities and under particular conditions; that it must be destroyed by processes of denudation, and obliterated by processes of metamorphosis. Beds of rock of any thickness, crammed full of organic remains, may yet, either by the percolation of water through them or by the influence of subterranean heat, lose all trace of these remains, and present the appearance of beds of rock formed under conditions in which living forms were absent. Such metamorphic rocks occur in formations of all ages; and in various cases there are very good grounds for the belief that they have contained organic remains, and that those remains have been absolutely obliterated.—HUXLEY *American Addresses*, lect. 2, p. 42. (A., 1898.)

1592. IMPERFECTIONS OF THE EYE—*Yet a Marvel to the Reflecting Mind.*—And here, in passing, I am reminded of the common delusion that the works of Nature, the human eye included, are theoretically perfect. The eye has grown for ages towards perfection; but ages of perfecting may be still before it. . . . A long list of indictments might indeed be brought against the eye—its opacity, its want of symmetry, its lack of achromatism, its absolute blindness, in part. All these taken together caused Helmholtz to say that if any optician sent him an instrument so full of defects he would be justified in sending it back with the severest censure. But the eye is not to be judged from the standpoint of theory. It is not perfect, as I have said, but on its way to perfection. As a practical instrument, and taking the adjustments by which its defects are neutralized into account, it must ever remain a marvel to the reflecting mind.—TYNDALL *Lectures on Light*, lect. 1, p. 8. (A., 1898.)

1593. IMPERIOUSNESS OF WRONG HABIT—*Student Revisiting Paris Unconsciously Seeks Old Room.*—Not only is it the right thing at the right time that we thus involuntarily do [when a habit has become fixed], but the wrong thing also, if it be an habitual thing. Who is there that has never wound up his watch on taking off his waistcoat in the daytime, or taken his latch-key out on arriving at the door-step of a friend? Very absent-minded persons in going to their bedroom to dress for dinner have been known to take off one garment after another and finally to get into bed, merely because that was the habitual issue of the first few movements when performed at a later hour. The writer well remembers how, on revisiting Paris after ten years' absence, and finding himself in the street in which for one winter he had attended school, he lost himself in a brown study, from which he was awakened by finding himself upon the stairs which led to the apartment in a house many streets away in which he had lived during that earlier time, and to which his steps from the school had then habitually led.—JAMES *Psychology*, vol. i, ch. 4, p. 114. (H. H. & Co., 1899.)

1594. IMPERSONATION—*The Dramatic Impulse Strong in Children.*—The dramatic impulse, the tendency to pretend one is some one else, contains this pleasure of mimicry as one of its elements. Another element seems to be a peculiar sense of power in stretching one's own personality so as to include that of a strange person. In young children this instinct often knows no bounds. For a few months in one of my children's third year, he literally hardly ever appeared in his own person. It was always, "Play I am So-and-so, and you are So-and-so, and the chair is such a thing, and then we'll do this or that." If you called him by his name, H., you invariably got the reply, "I'm not H., I'm a hyena, or a horse-car," or whatever the feigned object might be. He outwore this impulse after a time; but while it lasted it had every appearance of being the automatic result of ideas, often suggested by perceptions, working out irresistible motor effects.—JAMES *Psychology*, vol. ii, ch. 24, p. 409. (H. H. & Co., 1899.)

1595. IMPERSONATION CREATING MYTHS—*Origin of the Three Fates—Past, Present, Future.*—Another well-known mythic group shows again how what to us moderns are but ideas expressed in words, took personal form in the minds of the ancients. In the classic books of Greece and Rome we read of the three fate-spinners, the Moirai or Parcæ, and their Scandinavian counterparts appear in the Edda as the three wise women whose dwelling is near the spring under the world-ash Ygdrasill, the Norns who fix the lives of men. The explanation of these three mythic beings is that they are in personal shape the Past, Present, and Future, as is shown by the names they bear—Was, Is, Shall (Urdhr, Verdhandi, Skuld).—TYLOR *Anthropology*, ch. 15, p. 396. (A., 1899.)

1596. IMPLEMENTS, NATURAL, EFFECTIVENESS OF—*Bill of Macaw Surpasses Hammer—Hardest Nuts Crushed to*

Pulp.—We saw here, for the first time, the splendid hyacinthine macaw *(Macrocercus hyacinthinus*, Lath., the *araruna* of the natives), one of the finest and rarest species of the parrot family. It only occurs in the interior of Brazil, from 16° S. lat. to the southern border of the Amazons Valley. It is three feet long from the beak to the tip of the tail, and is entirely of a soft hyacinthine blue color, except round the eyes, where the skin is naked and white. It flies in pairs, and feeds on the hard nuts of several palms, but especially of the "mucuja" *(Acrocomia lasiospatha)*. These nuts, which are so hard as to be difficult to break with a heavy hammer, are crushed to a pulp by the powerful beak of this macaw.—BATES *Naturalist on the River Amazon*, ch. 4, p. 649. (Hum., 1880.)

1597. IMPOSTURE PRACTISED BY COWBIRD—We often see these birds feeding near cattle in the pastures, always in small flocks, for they do not pair nor even construct a nest, the female laying her egg in the nest of another and generally smaller species. Few birds seem aware of the imposture, and not only do they incubate the egg, but they may attend to the demands of the young cowbird at the expense of their own offspring, who sometimes die of starvation. Even after leaving the nest the young parasite continues its call for food, and when seeing a Maryland yellowthroat or some other small bird feeding a clumsy fledgling twice its size, one wonders it does not detect the deception.—CHAPMAN *Bird-Life*, ch. 7, p. 174. (A., 1900.)

1598. IMPRESSION ON PREPARED NERVE-CENTER—*Apperception—The Lover's Tap—The Friend's Voice.*—This reenforcement of ideas and impressions by the preexisting contents of the mind was what Herbart had in mind when he gave the name of "apperceptive attention" to the variety we describe. We easily see now why the lover's tap should be heard—it finds a nerve-center half ready in advance to explode. We see how we can attend to a companion's voice in the midst of noises which pass unnoticed tho objectively much louder than the words we hear. Each word is doubly awakened; once from without by the lips of the talker, but already before that from within by the premonitory processes irradiating from the previous words, and by the dim arousal of all processes that are connected with the "topic" of the talk. The irrelevant noises, on the other hand, are awakened only once. They form an unconnected train. The boys at school, inattentive to the teacher except when he begins an anecdote, and then all pricking up their ears, are as easily explained. The words of the anecdote shoot into association with exciting objects which react and fix them; the other words do not.—JAMES *Psychology*, vol. i, ch. 11, p. 450. (H. H. & Co., 1899.)

1599. IMPRESSION, WEAK, OBLITERATED BY STRONG—*Tick of Clock—Light of Stars—Slight Weight Added to Heavier Weight.*—Every one knows that in the stillness of night we hear things which are unperceived in the noise of day. The gentle ticking of the clock, the distant bustle of the streets, the creaking of the chairs in the room, impress themselves upon our ear. And every one knows that amid the confused hubbub of the market-place or the roar of a railway-train we may lose what our neighbor is saying to us, or even fail to hear our own voice. . . . The tick of the clock is a weak stimulus for our auditory nerves, which we hear plainly when it is given by itself, but not when it is added to a strong stimulus of rattling wheels and all the other turmoil. The light of the stars is a stimulus for the eye; but if its stimulation is added to the strong stimulus of daylight, we do not notice it, altho we sense it clearly when it is joined to the weak stimulus of twilight. The gram weight is a stimulus for our skin which we sense when it is united to a present stimulus of equal strength, but which vanishes when it is combined with a stimulus of a thousand times its own intensity.—WUNDT *Psychology*, lect. 2, p. 22. (Son. & Co., 1896.)

1600. IMPRESSIONS OF CHILDHOOD A STIMULUS TO SCIENTIFIC PURSUITS—*Stories of Adventure Combine with Love of Science.*—The longing wish I felt to behold the Pacific from the lofty ridges of the Andes was mingled with recollections of the interest with which, as a boy, I had dwelt on the narrative of the adventurous expedition of Vasco Nuñez de Balboa. That happy man, whose track Pizarro followed, was the first to behold, from the heights of Quarequa, on the Isthmus of Panama, the eastern part of the great "South Sea." The reedy shores of the Caspian, viewed from the point whence I first beheld them, viz., from the delta formed by the mouths of the Volga, cannot certainly be called picturesque, yet the delight I felt on first beholding them was enhanced by the recollection that, in my very earliest childhood, I had been taught to observe, on the map, the form of the Asiatic inland sea. The impressions aroused within us in early childhood, or excited by the accidental circumstances of life, frequently, in after-years, take a graver direction, and become stimulants to scientific labors and great enterprises.—HUMBOLDT *Views of Nature*, p. 417. (Bell, 1896.)

1601. IMPRINT OF RAIN-DROPS—*Enduring Record of the Evanescent.*—When a shower of rain falls, the highest portion of the mud-covered flat is usually too hard to receive any impressions; while that recently uncovered by the tide near the water's edge is too soft. Between these areas a zone occurs, almost as smooth and even as a looking-glass, on which every drop forms a cavity of circular or oval form,

and, if the shower be transient, these pits retain their shape permanently, being dried by the sun, and being then too firm to be effaced by the action of the succeeding tide, which deposits upon them a new layer of mud. Hence we often find, in splitting open a slab an inch or more thick, on the upper surface of which the marks of recent rain occur, that an inferior layer, deposited during some previous rise of the tide, exhibits on its under side perfect casts of rain-prints, which stand out in relief, the molds of the same being seen on the layer below.—LYELL *Principles of Geology*, bk. ii, ch. 14, p. 202. (A., 1854.)

1602. IMPROVEMENT CEASES WITH LACK OF COMPETITION—*The Humming-bird Has No Rival in Its Own Field.*—It is perhaps a law of Nature that when a species (or group) fits itself to a place not previously occupied, and in which it is subject to no opposition from beings of its own class, or where it attains so great a perfection as to be able easily to overcome all opposition, the character eventually loses its original plasticity, or tendency to vary, since improvement in such a case would be superfluous, and becomes, so to speak, crystallized in that form which continues thereafter unaltered. It is, at any rate, clear that while all other birds rub together in the struggle for existence, the humming-bird, owing to its aerial life and peculiar manner of seeking its food, is absolutely untouched by this kind of warfare, and is accordingly as far removed from all competition with other birds as the solitary savage is removed from the struggle of life affecting and modifying men in crowded communities. The lower kind of competition affecting humming-birds, that with insects, and, within the family, of species with species, has probably only served to intensify their unique characteristics, and, perhaps, to lower their intelligence.—HUDSON *Naturalist in La Plata*, ch. 16, p. 217. (C. & H., 1895.)

1603. IMPULSE FOR HABITUAL MOVEMENT SUPPLIED BY LAST PRECEDING MOVEMENT—In action grown habitual, what instigates each new muscular contraction to take place in its appointed order is not a thought or a perception, but the sensation occasioned by the muscular contraction just finished. A strictly voluntary act has to be guided by idea, perception, and volition, throughout its whole course. In an habitual action, mere sensation is a sufficient guide, and the upper regions of the brain and mind are set comparatively free.—JAMES *Psychology*, vol. i, ch. 4, p. 115. (H. H. & Co., 1899.)

1604. IMPULSE, MIGRATORY, IN CAGE-BIRDS—*Desertion of Young by Mother-birds—An Instinct Stronger than Maternal Affection.*—Nearly every bird is, indeed, more or less migratory; that is, it changes its quarter to a certain extent according to the season of the year. Even cage-birds, reared from the eggs of parents who never knew what freedom was, get as uneasy as a Londoner in August, and if their prison-doors are left open will sometimes desert their helpless young in order not to be too late for the winter hegira. The house-martin has been known to do so repeatedly; and if the autumn is colder than usual, the swallow and the Carolina waxwing will suddenly take their departure from Canada, leaving their callow brood to die of starvation, the instinct of self-preservation being evidently stronger than that of maternal affection.—BROWN *Nature-Studies*, p. 14. (Hum., 1888.)

1605. IMPULSE TO ACQUISITION—*Loss Involves Seeming Shrinkage of Ourselves.*—An . . . instinctive impulse drives us to collect property; and the collections thus made become, with different degrees of intimacy, parts of our empirical selves. The parts of our wealth most intimately ours are those which are saturated with our labor. There are few men who would not feel personally annihilated if a lifelong construction of their hands or brains—say an entomological collection or an extensive work in manuscript—were suddenly swept away. The miser feels similarly towards his gold, and altho it is true that a part of our depression at the loss of possessions is due to our feeling that we must now go without certain goods that we expected the possessions to bring in their train, yet in every case there remains, over and above this, a sense of the shrinkage of our personality, a partial conversion of ourselves to nothingness, which is a psychological phenomenon by itself. We are all at once assimilated to the tramps and poor devils whom we so despise, and at the same time remove farther than ever away from the happy sons of earth who lord it over land and sea and men in the full-blown lustihood that wealth and power can give, and before whom, stiffen ourselves as we will by appealing to anti-snobbish first principles, we cannot escape an emotion, open or sneaking, of respect and dread.—JAMES *Psychology*, vol. i, ch. 10, p. 293. (H. H. & Co., 1899.)

1606. IMPULSES RIPEN SUCCESSIVELY—*The Flowering-time an Opportunity To Be Seized.*—In children we observe a ripening of impulses and interests in a certain determinate order. Creeping, walking, climbing, imitating vocal sounds, constructing, drawing, calculating, possess the child in succession; and in some children the possession, while it lasts, may be of a semi-frantic and exclusive sort. Later, the interest in any one of these things may wholly fade away. Of course, the proper pedagogic moment to work skill in, and to clench the useful habit, is when the native impulse is most acutely present. Crowd on the athletic opportunities, the mental arithmetic, the verse-learning, the drawing, the botany,

or what not, the moment you have reason to think the hour is ripe. The hour may not last long, and while it continues you may safely let all the child's other occupations take a second place. In this way you economize time and deepen skill; for many an infant prodigy, artistic or mathematical, has a flowering epoch of but a few months. —JAMES *Talks to Teachers,* ch. 7, p. 61. (H. H. & Co., 1900.)

1607. IMPURITIES REJECTED BY GLACIER—*Popular Belief Founded on Scientific Fact.*—A notion [has been] long entertained by the inhabitants of the high Alps, that glaciers possess the power of thrusting out all impurities from them. On the Mer de Glace I have noticed large patches of clay and black mud which evidently came from the body of the glacier, and can therefore understand how natural was this notion of extrusion to people unaccustomed to close observation. But the power of the glacier in this respect is in reality the power of the sun, which fuses the ice above concealed impurities, and, like the bodies of the guides on the Glacier des Bossons, brings them to the light of day.—TYNDALL *Forms of Water,* p. 144. (A., 1899.)

1608. IMPURITY OF NATURAL COLORS—*Green Leaves Seen Red and Blue.*—The impurity of natural colors is strikingly illustrated by an observation recently communicated to me by Mr. Woodbury. On looking through a blue glass at green leaves in sunshine, he saw the superficially reflected light, blue. The light, on the contrary, which came from the body of the leaves was crimson. On examination, I found that the glass employed in this observation transmitted both ends of the spectrum, the red as well as the blue, and that it quenched the middle. This furnished an easy explanation of the effect. In the delicate spring foliage the blue of the solar light is for the most part absorbed, and a light, mainly yellowish green, but containing a considerable quantity of red, escapes from the leaf to the eye. On looking at such foliage through the violet glass, the green and the yellow are stopped, and the red alone reaches the eye. Thus regarded, therefore, the leaves appear like faintly blushing roses, and present a very beautiful appearance. With the blue ammonia-sulfate of copper, which transmits no red, this effect is not obtained. As the year advances the crimson gradually hardens to a coppery red; and in the dark-green leaves of old ivy it is almost absent. Permitting a concentrated beam of white light to fall upon fresh leaves in a dark room, the sudden change from green to red, and from red back to green, when the violet glass is alternately introduced across the beam and withdrawn, is very surprising. Looked at through the same glass, the meadows in May appear of a warm purple.—TYNDALL *Lectures on Light,* lect. 1, p. 38. (A., 1898.)

1609. INATTENTION TO THE UNIMPORTANT—*Habitual Sensations Ignored—Din of Foundry Unnoticed by Its Workers.*—We do not notice the ticking of the clock, the noise of the city streets, or the roaring of the brook near the house; and even the din of a foundry or factory will not mingle with the thoughts of its workers, if they have been there long enough. When we first put on spectacles, especially if they be of certain curvatures, the bright reflections they give of the windows, etc., mixing with the field of view, are very disturbing. In a few days we ignore them altogether. Various entoptic images, *muscæ volitantes* [flitting specks before the eyes], etc., altho constantly present, are hardly ever known. The pressure of our clothes and shoes, the beating of our hearts and arteries, our breathing, certain stedfast bodily pains, habitual odors, tastes in the mouth, etc., are examples from other senses of the same lapse into unconsciousness of any too unchanging content—a lapse which Hobbes has expressed in the well-known phrase, "*Semper idem sentire ac non sentire ad idem revertunt*" [To feel always and not to feel at all come to the same thing].—JAMES *Psychology,* vol. i, ch. 11, p. 455. (H. H. & Co., 1899.)

1610. INCANDESCENCE, COLORS OF, NO PICTURE CAN REPRESENT—*Splendor of Sun's Corona Defies Artist's Skill.*—Pictures are sometimes drawn which attempt to show the color of these [solar] flames. Some of these have been made at the Observatory of Harvard College, United States, where these phenomena are observed with the greatest care. On one of these plates two magnificent prominences of more than 60,000 miles in height are shown, the first observed on April 29, 1872, at 10 o'clock in the morning (25 minutes later it had so much changed that it was not to be recognized); the second, on April 15 of the same year, at the same hour. We may thus gain a better impression of them than by black figures. But there is something which a picture can never reproduce—the vivacity of the tints which these enormous masses present, and the rapidity of the motions with which they are animated. The best drawings will always be bodies without life, veritable corpses, if we compare them with the grand phenomena of Nature. These incandescent masses are animated with an internal activity, from which life seems to breathe. They shine with a vivid light, and the colors which adorn them form a specific character, by which we can recognize, thanks to spectrum analysis, the chemical nature of the substances which compose them. Could the most perfect drawings depict this solar life?—FLAMMARION *Popular Astronomy,* bk. iii, ch. 4, p. 275. (A.)

1611. INCANDESCENCE, PHENOMENA OF—*Black Bodies Emit Most Intense Light.*—We have employed as our source of

light in these lectures the ends of two rods of coke, rendered incandescent by electricity. Coke is particularly suitable for this purpose, because it can bear intense heat without fusion or vaporization. It is also black, which helps the light; for other circumstances being equal, as shown experimentally by Professor Balfour Stewart, the blacker the body the brighter will be its light when incandescent.—TYNDALL *Lectures on Light*, lect. 6, p. 192. (A., 1898.)

1612. INCLUSION VS. EXCLUSION—*Value of Each in Scientific Research—Newton United Caution and Intrepidity.*—He [Sir Isaac Newton] wanted no other recommendation for any one article of science than the recommendation of evidence—and, with this recommendation, he opened to it the chamber of his mind, tho authority scowled upon it, and taste was disgusted by it, and fashion was ashamed of it, and all the beauteous speculation of former days was cruelly broken up by this new announcement of the better philosophy, and scattered like the fragments of an aerial vision, over which the past generations of the world had been slumbering their profound and their pleasing reverie. But, on the other hand, should the article of science want the recommendation of evidence, he shut against it all the avenues of his understanding, and tho all antiquity lent their suffrages to it, and all eloquence had thrown around it the most attractive brilliancy, and all habit had incorporated it with every system of every seminary in Europe, and all fancy had arrayed it in graces of the most tempting solicitation, yet was the steady and inflexible mind of Newton proof against this whole weight of authority and allurement, and, casting his cold and unwelcome look at the specious plausibility, he rebuked it from his presence. The strength of his philosophy lay as much in refusing admittance to that which wanted evidence as in giving a place and an occupancy to that which possessed it.—CHALMERS *Astronomical Discourses*, p. 48. (R. Ct., 48.)

1613. INCOMPATIBILITY OF MENTAL QUALITIES—*Activity vs. Sensibility—Intellect vs. Emotion—Each Form of Greatness Has Its Own Sphere.*—Great activity and great sensibility are extreme phases, each using a large amount of power, and therefore scarcely to be coupled in the same system. The active, energetic man, loving activity for its own sake, moving in every direction, wants the delicate circumspection of another man who does not love activity for its own sake, but is energetic only at the spur of his special ends. And, once more, great intellect as a whole is not readily united with a large emotional nature. The incompatibility is best seen by inquiring whether men of overflowing sociability are deep and original thinkers, great discoverers, accurate inquirers, great organizers in affairs, or whether their greatness is not limited to the spheres where feeling performs a part—poetry, eloquence and social ascendency.—BAIN appendix to *Conservation of Energy* by STEWART, p. 431. (Hum.)

1614. INCREASE BY DESTRUCTION—*Gas Weighs More than the Coal Producing It.*—A large part of the structure of the earth's crust is formed of a substance called limestone. Ordinary limestone is a compound of common lime and carbon dioxid, a gas that is found mixed with the air to a very small degree. Carbon dioxid will be better known by the older people as carbonic acid. It is a gas that is given off whenever wood and coal are burned, or any substance containing carbon. It is composed of one atom of carbon to two of oxygen. Every ton of carbon that is burned sends off three and two-thirds tons of this gas. The increase in weight comes from the fact that every atom of carbon unites with two of oxygen, which it takes from the air, and the oxygen is heavier than the carbon. In comparing the relative weights of atoms (the smallest combinable particle of a solid, liquid, or gas) we use the hydrogen atom as the unit of comparison and call it "one," because it is the lightest of all atoms. The carbon atom is twelve times and the oxygen atom sixteen times as heavy as the hydrogen atom. Hence it will be seen readily how a ton of carbon will form three and two-thirds times its weight of carbon dioxid. Lime, having a strong affinity or attraction for this gas, has absorbed it from the air and water, forming what is known as carbonate of lime, which is the ordinary limestone.—ELISHA GRAY *Nature's Miracles*, vol. i, ch. 2, p. 12. (F. H. & H., 1900.)

1615. INCREASE OF ANIMALS UNDER PROTECTION—*The South-American Coypú—Change of Habits—Sudden Extermination.*—The coypú was much more abundant fifty years ago than now, and its skin, which has a fine fur under the long coarse hair, was largely exported to Europe. About that time the dictator Rosas issued a decree prohibiting the hunting of the coypú. The result was that the animals increased and multiplied exceedingly, and abandoning their aquatic habits they became terrestrial and migratory, and swarmed everywhere in search of food. Suddenly a mysterious malady fell on them, from which they quickly perished, and became almost extinct.—HUDSON *Naturalist in La Plata*, ch. 1, p. 12. (C. & H., 1895.)

1616. INCREASE OF EUROPEAN CATTLE IN THE NEW WORLD—Columbus, in his second voyage, left a few black cattle at Santo Domingo, and these ran wild and increased so much that twenty-seven years afterwards herds of from 4,000 to 8,000 head were not uncommon. Cattle were afterwards taken from this island to Mexico and to other parts of America, and in 1587, sixty-five years after the conquest of Mexico,

the Spaniards exported 64,350 hides from that country and 35,444 from Santo Domingo, an indication of the vast numbers of these animals which must then have existed there, since those captured and killed could have been only a small portion of the whole.—WALLACE *Darwinism*, ch. 2, p. 18. (Hum., 1889.)

1617. INCREASE OF HEAT FROM VIOLET TO RED AND BEYOND—Throwing a small and concentrated spectrum upon a screen, by means of an endless screw we move [a thermopile] . . . through the entire spectrum, and determine in succession the thermal power of all its colors. When this instrument is brought to the violet end of the spectrum the heat is found to be almost insensible. As the pile gradually moves from the violet towards the red, it encounters a gradually augmenting heat. The red itself possesses the highest heating power of all the colors of the spectrum. Pushing the pile into the dark space beyond the red, the heat rises suddenly in intensity, and at some distance beyond the red it attains a maximum. From this point the heat falls somewhat more rapidly than it rose, and afterwards gradually fades away. —TYNDALL *Lectures on Light*, lect. 5, p. 189. (A., 1898.)

1618. INCREASE OF SURFACE IN LUNG—*Device of the Diaphragm—Respiratory Power in Small Compass.*—In the lung of man, as of mammals generally, an extraordinary increase is given to the extent of aerating surface, by the excessively minute subdivision of the cavity into air-cells, of which thousands are clustered round the end of each terminal twig of the bronchial tree. But this increase would be without effect if there were not at the same time a most elaborate provision in the skeleton of the trunk, in the disposition of its muscles, and in the mode in which these are acted on by the nervous apparatus, for alternately filling and emptying the lungs, so as to take in fresh supplies of oxygen for the aeration of the blood, and to get rid of the carbonic acid which it gives off. The chief feature in this provision is the enclosure of the lungs in a distinct cavity (that of the chest) cut off from the abdomen by a muscular partition, the diaphragm, the contraction of which, by increasing the capacity of the chest, produces an inrush of air down the air-passages, which penetrates to the remotest parts of the minutely subdivided cavity of the lungs. By no other action could the air contained in that cavity be so effectually renewed. Thus the pulmonary apparatus of the mammal is the most perfect form that could be devised for obtaining the highest amount of respiratory power within the smallest compass.—CARPENTER *Nature and Man*, lect. 15, p. 461. (A., 1889.)

1619. INCREASE, SIMULTANEOUS, OF HUMBLEBEES AND MICE—*Fowls Made Rapacious Mousers.*—In the summer of 1872-73 we had plenty of sunshine, with frequent showers, so that the hot months brought no dearth of wild flowers, as in most years. The abundance of flowers resulted in a wonderful increase of humblebees. I have never known them so plentiful before; in and about the plantation adjoining my house I found during the season no fewer than seventeen nests. The season was also favorable for mice—that is, of course, favorable for the time being, unfavorable in the long run, since the short-lived, undue preponderance of a species is invariably followed by a long period of undue depression. These prolific little creatures were soon so abundant that the dogs subsisted almost exclusively on them; the fowls also, from incessantly pursuing and killing them, became quite rapacious in their manner, whilst the sulfur tyrant-birds *(Pitangus)* and the Guira cuckoos preyed on nothing but mice.—HUDSON *Naturalist in La Plata*, ch. 3, p. 59. (C. & H., 1895.)

1620. INCREASE, VAST POSSIBLE, OF BIRDS—*Vast Consequent Destruction—Slaughter Unperceived.*—Let us now consider a less extreme and more familiar case. We possess a considerable number of birds which, like the redbreast, sparrow, the four common titmice, the thrush, and the blackbird, stay with us all the year round. These lay on an average six eggs, but as several of them have two or more broods a year ten will be below the average of the year's increase. Such birds as these often live from fifteen to twenty years in confinement, and we cannot suppose them to live shorter lives in a state of nature, if unmolested: but to avoid possible exaggeration we will take only ten years as the average duration of their lives. Now, if we start with a single pair, and these are allowed to live and breed, unmolested, till they die at the end of ten years, . . . their numbers would amount to more than twenty millions. But we know very well that our bird population is no greater, on the average, now than it was ten years ago. . . . What, then, becomes of the enormous surplus population annually produced? It is evident they must all die or be killed, somehow; and as the increase is, on the average, about five to one, it follows that if the average number of birds of all kinds in our islands is taken at ten millions—and this is probably far under the mark—then about fifty millions of birds, including eggs as possible birds, must annually die or be destroyed. Yet we see nothing, or almost nothing, of this tremendous slaughter of the innocents going on all around us.—WALLACE *Darwinism*, ch. 2, p. 17. (Hum., 1889.)

1621. INCREDULITY HINDERS INVESTIGATION—*All Evidence of Meteorites Once Rejected.*—That arrogant spirit of incredulity which rejects facts without attempting to investigate them is in some cases almost more injurious than an unques-

tioning credulity. Both are alike detrimental to the force of investigation. Notwithstanding that for more than two thousand years the annals of different nations had recorded falls of meteoric stones, many of which had been attested beyond all doubt by the evidence of irreproachable eye-witnesses; notwithstanding the important part enacted by the bætyli in the meteor-worship of the ancients; notwithstanding the fact of the companions of Cortez having seen an aerolite at Cholula which had fallen on the neighboring pyramid; notwithstanding that califs and Mongolian chiefs had caused swords to be forged from recently fallen meteoric stones; nay, notwithstanding that several persons had been struck dead by stones falling from heaven, as, for instance, a monk at Crema on the 4th of September, 1511, another monk at Milan in 1650, and two Swedish sailors on board ship in 1674—yet this great cosmical phenomenon remained almost wholly unheeded, and its intimate connection with other planetary systems unknown, until attention was drawn to the subject by Chladni.—HUMBOLDT *Cosmos*, vol. i, p. 135. (H., 1897.)

1622. INDEPENDENCE WEAKENED BY SURVEILLANCE — *"Mother's Apron-strings"—Lack of Moral Perspective.*—It is an old and just observation that youths who have been "brought up at their mothers' apron-strings" are the most likely to "go wrong" when first thrown upon their own guidance; and that when such once begin to go astray they soonest run into wild excesses. The rationale of this seems to be that the tendency of such an education is usually to repress, instead of fostering, habits of independence and self-regulation; and too frequently to weaken, instead of strengthening, the force of moral obligation, by attaching to small things the same importance as to great. If a lad is constantly watched and never trusted, he is almost sure to abuse his liberty when he first acquires it. And if he is taken to task as severely for spilling ink on a table-cloth or for tearing his clothes, as for telling a lie or appropriating what does not belong to him, it is not to be wondered at that he should come to regard the graver offenses in the same light as those which he feels to be venial.—CARPENTER *Mental Physiology*, bk. i, ch. 9, p. 427. (A., 1900.)

1623. INDESTRUCTIBILITY OF THE ATOM—*An Unproved Assumption.*—The supposed indestructibility of the atom amounts merely to this, that with our limited range of experimental methods we have not been able to cause any appreciable portion of matter to disappear, as such, permanently, but can always recover it unchanged in mass and chemical properties. To assert that matter cannot, under any circumstances, be made to disappear as matter, seems to me to be the most unjustifiable dogma imaginable.—STOKES *The Atomic Theory from the Chemical Standpoint*, in *Science*, N. S., vol. xi, No. 277, April 20, 1900.

1624. INDESTRUCTIBILITY OF THREE GREAT POWERS—*Matter, Energy, Intelligence Imperishable.*—All modern chemistry rests on the great truth that *matter is indestructible, and is measured by weight*. . . . Another great central truth, more recently discovered, is not less far-reaching or important, namely, *energy is indestructible, and is measured by work*. Add to these two [truths] a third, namely, *intelligence is indestructible, and is measured by adaptation*, and you have, as it seems to me, the three great manifestations of Nature: *Matter, energy, and intelligence.* These great truths explain and supplement each other. Give to each its due weight in your philosophy, and you will avoid the extremes of idealism on the one side, and of materialism on the other.—COOKE *New Chemistry*, lect. 10, p. 235. (A., 1899.)

1625. INDIFFERENCE TO CATASTROPHE—*Lack of Record Is Not Disproof of Event.*—We must not conclude without alluding to a moral phenomenon connected with this tremendous catastrophe [the volcanic eruption in Sumbawa in 1815], which we regard as highly deserving the attention of geologists. It is stated by Sir A. Burnes that "these wonderful events passed unheeded by the inhabitants of Cutch"; for the region convulsed, tho once fertile, had for a long period been reduced to sterility by want of irrigation, so that the natives were indifferent as to its fate. Now it is to this profound apathy which all but highly civilized nations feel, in regard to physical events not having an immediate influence on their worldly fortunes, that we must ascribe the extraordinary dearth of historical information concerning changes of the earth's surface, which modern observations show to be by no means of rare occurrence in the ordinary course of Nature.

Since the above account was written, a description has been published of more recent geographical changes in the district of Cutch, near the mouth of the Koree, or eastern branch of the Indus, which happened in June, 1845. A large area seems to have subsided, and the Sindree Lake has become a salt marsh.—LYELL *Principles of Geology*, bk. ii, ch. 27, p. 464. (A., 1854.)

1626. INDIGO MANUFACTURED BY CHEMICAL PROCESS—*Indigo Farms Abandoned.*—To such an extent has this [manufacture of substances like the organic] been the case that in several instances the old methods of producing certain chemical compounds through the medium of cultivated plants has been entirely abandoned. Perhaps the most striking illustration of this is in the case of the indigo-plant. The cultivation of this plant and the manufacture of indigo therefrom were once profitable in-

dustries, but the manufacture of synthetic indigo and its substitutes in the chemical laboratory has so cheapened the price of this product as to render unprofitable the old processes. The indigo farms are therefore abandoned, and nearly the whole of the indigo of commerce is now manufactured by the chemist.—WILEY *Relations of Chemistry to Industrial Progress (Address at Purdue University, Lafayette, Ind.*, 1896, p. 28).

1627. INDIVIDUALISM CONTRARY TO NATURE'S PLAN—*Care Bestowed in Preparing Pollen—Precautions against Self-fertilization of Flowers.*—If we consider how precious a substance pollen is, and what care has been bestowed on its elaboration and on the accessory parts in the *Orchideæ*—considering how large an amount is necessary for the impregnation of the almost innumerable seeds produced by these plants—considering that the anther stands close behind or above the stigma, self-fertilization would have been an incomparably safer and easier process than the transportal of pollen from flower to flower. Unless we bear in mind the good effects which have been proved to follow in most cases from cross-fertilization, it is an astonishing fact that the flowers of the *Orchideæ* should not have been regularly self-fertilized. It apparently demonstrates that there must be something injurious in this latter process, of which fact I have elsewhere given direct proof. It is hardly an exaggeration to say that Nature tells us, in the most emphatic manner, that she abhors perpetual self-fertilization.—DARWIN *Fertilization of Orchids*, ch. 9, p. 293. (A., 1898.)

1628. INDIVIDUALISM GIVES PLACE TO ALTRUISM—Now the moment a man's voluntary actions are determined by conscious or unconscious reference to a standard outside of himself and his selfish motives, he has entered the world of ethics, he has begun to live in a moral atmosphere. Egoism has ceased to be all in all, and altruism—it is an ugly-sounding word, but seems to be the only one available—altruism has begun to assert its claim to sovereignty.—FISKE *Through Nature to God*, pt. ii, ch. 9, p. 104. (H. M. & Co., 1900.)

1629. INDIVIDUALITY A LAW OF NATURE—*No Organism Exactly Like Parent.*—Equally conspicuous with the truth that every organism bears a general likeness to its parents, is the truth that no organism is exactly like either parent. Tho similar to both in generic and specific traits, and usually, too, in those traits which distinguish the variety, it diverges in numerous traits of minor importance. No two plants are indistinguishable; and no two animals are without differences. Variation is coextensive with heredity.—SPENCER *Biology*, pt. ii, ch. 9, p. 320. (A., 1900.)

1630. INDIVIDUALITY INDESTRUCTIBLE—*No Complete Transference of Thought.*—The only states of consciousness that we naturally deal with are found in personal consciousnesses, minds, selves, concrete particular I's and you's. Each of these minds keeps its own thoughts to itself. There is no giving or bartering between them. No thought even comes into direct sight of a thought in another personal consciousness than its own. Absolute insulation, irreducible pluralism, is the law. It seems as if the elementary psychic fact were not *thought* or *this thought* or *that thought*, but *my thought*, every thought being *owned*. Neither contemporaneity, nor proximity in space, nor similarity of quality and content are able to fuse thoughts together which are sundered by this barrier of belonging to different personal minds. The breaches between such thoughts are the most absolute breaches in Nature.—JAMES *Psychology*, vol. i, ch. 9, p. 226. (H. H. & Co., 1899.)

1631. INDIVIDUALITY IN SCIENCE—*Variations and Discrepancies between Competent Observers—The "Personal Equation" in Observations.*—It was in 1823 that Bessel drew attention to discrepancies in the times of transits given by different astronomers. The quantities involved were far from insignificant. He was himself nearly a second in advance of all his contemporaries, Argelander lagging behind him as much as a second and a quarter. Each individual, in fact, was found to have a certain definite rate of perception, which, under the name of "personal equation," now forms so important an element in the correction of observations that a special instrument for accurately determining its amount in each case is in actual use at Greenwich.—CLERKE *History of Astronomy*, pt. i, ch. 6, p. 152. (Bl., 1893.)

1632. INDIVIDUALITY OF A REGION—*Each Has a Character of Its Own.*—As in some individual organic beings we recognize a definite physiognomy, and as descriptive botany and zoology are, strictly speaking, analyses of animal and vegetable forms, so also there is a certain natural physiognomy peculiar to every region of the earth. That which the painter designates by the expressions "Swiss scenery" or "Italian sky" is based on a vague feeling of the local natural character. The azure of the sky, the effects of light and shade, the haze floating on the distant horizon, the forms of animals, the succulence of plants, the bright glossy surface of the leaves, the outlines of mountains, all combine to produce the elements on which depends the impression of any one region.—HUMBOLDT *Views of Nature*, p. 217. (Bell, 1896.)

1633. INDIVIDUALITY OF MEMORY—*Seems Intuitive as Consciousness Itself.*—To challenge the veracity of a person's memory is one of the boldest things one can do in the way of attacking deep-seated conviction. Memory is the peculiar domain of the individual. In going back in recollection to the scenes of other years he is draw-

ing on the secret storehouse of his own consciousness, with which a stranger must not intermeddle. To cast doubt on a person's memory is commonly resented as an impertinence, hardly less rude than to question his reading of his own present mental state. Even if the challenger professedly bases his challenge on the testimony of his own memory, the challenged party is hardly likely to allow the right of comparing testimonies. He can in most cases boldly assert that those who differ from him are lacking in his power of recollection. The past, in becoming the past, has, for most people, ceased to be a common object of reference; it has become a part of the individual's own inner self, and cannot be easily dislodged or shaken.—SULLY *Illusions*, ch. 10, p. 232. (A., 1897.)

1634. INDIVIDUALITY, STRONG, IN CAT TRIBE—*Cats Never Hunt in Packs.*—Cats never hunt in packs as dogs and wolves do, and rarely pursue their prey in open ground, but spring upon it from some hiding-place. They are mostly nocturnal, and the greater number, especially of the smaller kinds, habitually live in trees.—MIVART *Types of Animal Life*, ch. 8, p. 226. (L. B. & Co., 1893.)

1635. INDIVIDUALITY, VARYING ASPECTS OF—*Men Discriminate between Their Own Different Selves—One's "Fame" and "Honor."*—A man's fame, good or bad, and his honor or dishonor are names for one of his social selves. The particular social self of a man called his honor is usually the result of one of those splittings of which we have spoken. It is his image in the eyes of his own "set" which exalts or condemns him as he conforms or not to certain requirements that may not be made of one in another walk of life. Thus a layman may abandon a city infected with cholera; but a priest or a doctor would think such an act incompatible with his honor. A soldier's honor requires him to fight or to die under circumstances where another man can apologize or run away with no stain upon his social self. A judge, a statesman, are in like manner debarred by the honor of their cloth from entering into pecuniary relations perfectly honorable to persons in private life. Nothing is commoner than to hear people discriminate between their different selves of this sort: "As a man I pity you, but as an official I must show you no mercy; as a politician I regard him as an ally, but as a moralist I loathe him," etc., etc.—JAMES *Psychology*, vol. i, ch. 10, p. 294. (H. H. & Co., 1899.)

1636. INDUCTION AND DEDUCTION MUST COMBINE—*No Single Method Leads to Truth.*—We must welcome as one of the most fortunate steps in the direction of a solution of the great cosmic problems the fact that of recent years there is a growing tendency to recognize the two paths which alone lead thereto—experience and thought, or speculation—to be of equal value and mutually complementary. Philosophers have come to see that pure speculation—such, for instance, as Plato and Hegel employed for the construction of their idealist systems—does not lead to knowledge of reality. On the other hand, scientists have been convinced that mere experience—such as Bacon and Mill, for example, made the basis of their realist systems—is sufficient of itself for a complete philosophy. For these two great paths of knowledge, sense-experience and rational thought, are two distinct cerebral functions; the one is elaborated by the sense-organs and the inner sense-centers, the other by the thought-centers, the great "centers of association in the cortex of the brain," which lie between the sense-centers. True knowledge is only acquired by combining the activity of the two.—HAECKEL *Riddle of the Universe*, ch. 1, p. 18. (H., 1900.)

1637. INDUCTION GIVES A LAW—*Deduction Supposes a Case—Experiment Furnishes the Test.*—To acquire [scientific] foreknowledge of what is coming, but of what has not been settled by observations, no other method is possible than that of endeavoring to arrive at the laws of facts by observations; and we can only learn them by induction, by the careful selection, collation, and observation of those cases which fall under the law. When we fancy that we have arrived at a law the business of deduction commences. It is then our duty to develop the consequences of our law as completely as may be, but in the first place only to apply to them the test of experience, so far as they can be tested, and then to decide by this test whether the law holds, and to what extent. This is a test which really never ceases.—HELMHOLTZ *Popular Lectures*, ser. ii, lect. 5, p. 226. (L. G. & Co., 1898.)

1638. INDUCTION RECOGNIZED BY ARISTOTLE—*Rules Given Only for Deduction.*—Altho the duality of the complex operation whereof induction is the first and deduction the second half, as well as the especial necessity for the inductive part, was recognized by Aristotle both in actual declarations and by his unwearied industry in collecting facts; altho, moreover, he perceived that all science or theory must rest upon this foundation as a whole, nevertheless he devotes himself only to the analysis and to the formulating of the rules of the deductive part. Thus it was, as Grote points out, that science afterwards became disjoined from experience and was presented as consisting in deduction alone, while everything not deduction became degraded into unscientific experience.—PARK BENJAMIN *Intellectual Rise in Electricity*, ch. 2, p. 39. (J. W., 1898.)

1639. INDULGENCE, EXCUSES FOR—*Mental Ingenuity in Finding Reasons for Wrong-doing—Fault Must Be Branded with the Name—"Being a Drunkard."*—Where,

however, the right conception is an anti-impulsive one, the whole intellectual ingenuity of the man usually goes to work to crowd it out of sight, and to find names for the emergency, by the help of which the dispositions of the moment may sound sanctified, and sloth or passion may reign unchecked. How many excuses does the drunkard find when each new temptation comes! It is a new brand of liquor which the interests of intellectual culture in such matters oblige him to test; moreover it is poured out and it is sin to waste it; or others are drinking and it would be churlishness to refuse; or it is but to enable him to sleep, or just to get through this job of work: or it isn't drinking, it is because he feels so cold; or it is Christmas day; or it is a means of stimulating him to make a more powerful resolution in favor of abstinence than any he has hitherto made; or it is just this once, and once doesn't count, etc., etc., *ad libitum*—it is, in fact, anything you like except *being a drunkard*. *That* is the conception that will not stay before the poor soul's attention. But if he once gets able to pick out that way of conceiving from all the other possible ways of conceiving the various opportunities which occur, if through thick and thin he holds to it that this is being a drunkard and is nothing else, he is not likely to remain one long. The effort by which he succeeds in keeping the right *name* unwaveringly present to his mind proves to be his saving moral act.—JAMES *Psychology*, vol. ii, ch. 26, p. 565. (H. H. & Co., 1899.)

1640. INDUSTRY AND PREVISION AMONG ANIMALS—*Storehouses and Gardens of Ants.*—The species of *Messor* (Europe), *Pogonomyrmex* (America), and *Holcomyrmex* (India) construct very large chambers, or granaries, underground, at a considerable depth, often at the depth of a yard, in which they store the seeds they have collected. In the same way the species of the American genus *Atta* excavate extremely deep and extensive passages, and make immense chambers, in which they store the leaves they have cut from the trees for the purpose of laying out upon them the fungus-gardens from which they supply thousands with food. This discovery, first made by Belt, and subsequently declared by MacCook to be incorrect, has recently been confirmed by Dr. Möller, of Blumenau, in its full extent as the result of superb experiments.—*Forel, Article on Ants' Nests*, p. 483 *(Report of Smithsonian Institute, 1894).*

1641. INDUSTRY DEPENDENT ON SCIENTIFIC STUDY—As in nobler spheres of thought and sentiment, in philosophy, poetry, and the fine arts, the object at which we aim ought to be an inward one—an ennoblement of the intellect—so ought we likewise, in our pursuit of science, to strive after a knowledge of the laws and the principles of unity that pervade the vital forces of the universe; and it is by such a course that physical studies may be made subservient to the progress of industry, which is a conquest of mind over matter. By a happy connection of causes and effects we often see the useful linked to the beautiful and the exalted. The improvement of agriculture in the hands of freemen, and on properties of a moderate extent—the flourishing state of the mechanical arts freed from the trammels of municipal restrictions—the increased impetus imparted to commerce by the multiplied means of contact of nations with each other are all brilliant results of the intellectual progress of mankind and of the amelioration of political institutions in which this progress is reflected. The picture presented by modern history ought to convince those who are tardy in awakening to the truth of the lesson it teaches.—HUMBOLDT *Cosmos*, vol. i, int., p. 54. (H., 1897.)

1642. INDUSTRY OF ANTS—*Systematic and Persevering Labor of Red Ants in India.*—Meer Hassan Ali, in his "History of the Mussulmans," expressly mentions that "More industrious little creatures cannot exist than the small red ants which are so abundant in India. I have watched them at their labors for hours without tiring. They are so small that from eight to twelve in number labor with great difficulty to convey a grain of wheat or barley, yet these are not more than half the size of a grain of English wheat. I have known them to carry one of these grains to their nest, at a distance from 600 to 1,000 yards. They travel in two distinct lines over rough or smooth ground, as it may happen, even up and down steps, at one regular pace. The returning unladen ants invariably salute the burthened ones who are making their way to the general storehouse; but it is done so promptly that the line is neither broken nor their progress impeded by the salutation."—AVEBURY *Ants, Bees and Wasps*, ch. 3, p. 60. (A., 1900.)

1643. INDUSTRY OF PRIMITIVE MAN—*Toil under Disadvantages.*—After having chosen a favorable situation the first step in the construction of the lake-habitations was to obtain the necessary timber. To cut down a tree with a stone hatchet must have been no slight undertaking. It is, indeed, most probable that use was made of fire in the same manner as is done by existing savages in felling trees and making canoes. Burning the wood and then scraping away the charred portion renders the task far more easy, and the men of the Stone period appear to have avoided the use of large trees, except in making their canoes. Their piles were embedded in the mud from one to five feet, and must also have projected from four to six feet above the water level, which cannot have been very different from what it is at present. They must, therefore, have had a length of from fifteen to thirty feet, and they were from three to nine inches in diameter. The point-

ed extremity which entered into the mud still bears the marks of the fire and the rude cuts made by the stone hatchets. The piles belonging to the Bronze period, being prepared with metal axes, were much more regularly pointed, and the differences between the two have been ingeniously compared to those shown by lead pencils well and badly cut.—AVEBURY *Prehistoric Times*, ch. 6, p. 176. (A., 1900.)

1644. INDUSTRY, SEPARATE VS. GREGARIOUS — *Ancient Implements Long Perpetuated—The Spindle of Egypt in the Highlands of Scotland.*—In 1760 the spinning-wheel and the common loom, as used by the people of Yorkshire, were little in advance of the implements for the same purpose which had been in use beyond the reach of history. The spindle which is depicted on the monuments of Egypt was until a few years ago familiar in the Highlands. The essential feature of this ancient industry, so far as its effects upon social conditions are concerned, was that it was separate and not gregarious. It did not interfere with, but rather was congenial to, family life for thousands of years.

"Maids at the wheel, the weaver at his loom,
Sat blithe and happy."

—ARGYLL *Reign of Law*, ch. 7, p. 206. (Burt.)

1645. INDUSTRY THE CORRECTIVE OF PHILANTHROPY—*Evolution Humanized.*—Men very naturally and very honestly disagree in respect to the activity of those causes which have helped the human race forward. Most of us accept the theory of evolution to account for the diversity and development of life, but when reason, education, and religion appear, they serve to counteract the forces which have produced evolution, and, in fact, to undo much of the work which the uninterrupted operation of natural law has performed. The tendency of civilization is therefore almost directly in opposition to those forces which have made humanity possible. As an illustration of this, attention may be called to the grand system of organized philanthropy which is found in every civilized community. The care which we bestow in public and in private on the old, the imbecile and the sick secures precisely what the great forces of evolution would eliminate and destroy. Were it not, then, for other forces to counteract the deteriorating effects of philanthropy, the human race, through its own excellence of heart, would rapidly regress. Fortunately, therefore, in the progress of human industry we find a factor which tends to correct or neutralize the enervating effects of philanthropy. The necessity of effort and the pleasure of labor drive men into pursuits which develop their faculties, increase their power, and eliminate, to a certain degree, the deteriorating effects of care, of helpfulness, of sympathy and affection. In this respect the progress of industry must be regarded as the great helper of humanity. Just in proportion as the industries of a nation broaden and develop, just in that proportion does the character of its citizens gain strength and their brains and muscles skill and power.—WILEY *Relations of Chemistry to Industrial Progress (Address at Purdue University, Lafayette, Ind., 1896)*, p. 13.

1646. INEQUALITY A LAW OF HUMAN NATURE—There is, for example, a law—an observed order of facts—in respect to man, which the working classes too often forget, but which can neither be violated nor neglected with impunity. That law is the law of inequality—the various degrees in which the gifts both of body and of mind are shared among men. This is one of the most fundamental facts of human nature. Nor is it difficult to see how it should be also one of the most beneficent. But it is a fact against which the spirit of combination is very apt to assume an attitude of permanent insurrection.—ARGYLL *Reign of Law*, ch. 7, p. 224. (Burt.)

1647. INFALLIBILITY, ASSUMED, OF SCIENTISTS—Many an anthropologist has described a skull of peculiar form as the only one of its kind, perhaps discovering in it greater or minor animal similarities, when typically it might have been mistaken for the one upon his own shoulders.—RANKE *Somatische anthropologische Beobachtungen (an address).* (Translated for *Scientific Side-Lights.)*

1648. INFANCY A PERIOD OF PLASTICITY—*Calls Out Parents' Unselfishness.*—The first appearance of infancy in the animal world heralded the new era which was to be crowned by the development of man. With the beginnings of infancy there came the first dawning of a conscious life similar in nature to the conscious life of human beings, and there came, moreover, on the part of parents, the beginning of feelings and actions not purely self-regarding. But, still more, the period of infancy was a period of plasticity. The career of each individual being no longer wholly predetermined by the careers of its ancestors, it began to become teachable. Individuality of character also became possible at the same time, and for the same reason.—FISKE *Destiny of Man*, ch. 6, p. 51. (H. M. & Co., 1900.)

1649. INFANCY PROLONGED—*Noticeable Fact among Apes.*—The young orangs seem to remain unusually long under their mother's protection, probably in consequence of their slow growth. While climbing the mother always carries her young against her bosom, the young holding on by his mother's hair.—HUXLEY *Man's Place in Nature*, p. 206. (Hum.)

1650. ——— ——— *The Chief Fact in Man's Development.*—In the genesis of humanity the central fact has been the in-

creased duration of infancy. Now, can we assign for that increased duration an adequate cause? I think we can. The increase of intelligence is itself such a cause. A glance at the animal kingdom shows us no such thing as infancy among the lower orders. It is with warm-blooded birds and mammals that the phenomena of infancy and the correlative parental care really begin.—FISKE *Through Nature to God*, pt. ii, ch. 6, p. 87. (H. M. & Co., 1900.)

1651. INFECTION CAUSED BY EARTHWORMS—Pasteur held that earthworms are responsible for conveying the spores and anthrax from buried carcasses to the surface, and thus bringing about reinfection.—NEWMAN *Bacteria*, ch. 5, p. 17. (G. P. P., 1899.)

1652. INFECTION WIDELY DISTRIBUTED—*Mistaken Attempt at Cleanliness Caused Pollution.*—Within the last twelve months much attention has been drawn to a milk-source of typhoid infection by the epidemic of typhoid at Bristol. Dr. D. S. Davies has pointed out that a brook received the sewage of thirty-seven houses, the overflow of a cesspool serving twenty-two more, the washings from fields over which the drainage of several others was distributed, and the direct sewage from at least one other, and then flowed directly through a certain farm. The water of this stream supplied the farm pump, and the water itself, it is scarcely necessary to add, was highly charged with putrescent organic matter and micro-organisms. This water was used for washing the milk-cans from this particular farm, otherwise the dairy arrangements were efficient. Part of the milk was distributed to fifty-seven houses in Clifton; in forty-one of them cases of typhoid occurred. Another part of the milk was sold over the counter; twenty households so obtaining it were attacked with typhoid fever, and a number of further infections and complications arose. This evidence would appear to support the fact that milk may act in the same way, tho not in such a high degree, as water in the conveyance of typhoid fever.—NEWMAN *Bacteria*, ch. 6, p. 199. (G. P. P., 1899.)

1653. INFINITUDE, RICHTER'S VISION OF—*"End There Is None!"*—Truly, the German poet Richter has spoken well in those wonderful words which our own prose poet De Quincey has so nobly translated; his splendid vision aptly expresses the feebleness of man's conceptions in the presence of the infinite wonders of creation:

"God called up from dreams a man into the vestibule of heaven, saying, 'Come thou hither, and see the glory of my house.' And to the angels which stood around his throne he said: 'Take him, strip from him his robes of flesh; cleanse his vision, and put a new breath into his nostrils, only touch not with any change his human heart, the heart that weeps and trembles.' It was done; and with a mighty angel for his guide the man stood ready for his infinite voyage; and from the terraces of heaven, without sound or farewell, at once they wheeled away into endless space. Sometimes with the solemn flight of angel wings they passed through Zaharas of darkness, through wildernesses of death, that divided the worlds of life; sometimes they swept over frontiers that were quickening under prophetic motions from God. Then from a distance which is counted only in heaven, light dawned for a time through a shapeless film; by unutterable pace the light swept to them, they by unutterable pace to the light. In a moment the rushing of planets was upon them; in a moment the blazing of suns was around them.

"Then came eternities of twilight, that revealed, but were not revealed. On the right hand and on the left towered mighty constellations, that by self-repetitions and answers from afar, that by counter-positions, built up triumphal gates, whose architraves, whose archways, horizontal, upright, rested, rose, at altitude, by spans that seemed ghostly from infinitude. Without measure were the architraves, past number were the archways, beyond memory the gates. Within were stairs that scaled the eternities around; above was below and below was above, to the man stripped of gravitating body: depth was swallowed up in height insurmountable, height was swallowed up in depth unfathomable. Suddenly, as thus they rode from infinite to infinite, suddenly, as thus they tilted over abysmal worlds, a mighty cry arose that systems more mysterious, that worlds more billowy, other heights and other depths, were coming, were nearing, were at hand.

"Then the man sighed and stopped, shuddered, and wept. His overladen heart uttered itself in tears, and he said, 'Angel, I will go no farther: for the spirit of man acheth with this infinity. Insufferable is the glory of God. Let me lie down in the grave, and hide me from the persecution of the Infinite, for end I see there is none.' And from all the listening stars that shone around issued a choral voice, 'The man speaketh truly: end there is none that ever yet we heard of!' 'End is there none?' the angel solemnly demanded: 'is there indeed no end? And is this the sorrow that fills you?' But no voice answered, that he might answer himself. Then the angel threw up his glorious hands to the heaven of heavens, saying: 'End is there none to the universe of God. Lo! also, there is no beginning.'"—PROCTOR *Expanse of Heaven*, p. 304. (L. G. & Co., 1897.)

1654. INFINITY A NECESSITY OF HUMAN THOUGHT—*Space and Time—Matter and Force.*—When now we consider the place in the whole system of our knowledge which is occupied by these great fundamental conceptions of time and space, and of matter and of force, and when we con-

sider that we cannot even think of any one of these realities as capable of coming to an end, we may well be assured that, whatever may be the limits of the human mind, they certainly do not prevent us from apprehending infinity. On the contrary, it would rather appear that this apprehension is the invariable and necessary result of every investigation of Nature.—ARGYLL *Unity of Nature*, ch. 4, p. 84. (Burt.)

1655. INFINITY NOT AN OBJECT OF WORSHIP—*Infinite Space, Time, Number Not Religious—Misfortune of Ambiguity.*—The phrase, now often used to express the objects of religious thought and feeling, "the Infinite," is . . . ambiguous, not merely as "the Supernatural" is ambiguous, by reason of its involving a separate and adventitious meaning besides the meaning which is prominent and essential; but it is ambiguous by reason of not necessarily containing at all the one meaning which is essential to religion. "The Infinite" is a pure and bare abstraction, which may or may not include the one only object of religious consciousness and thought. An Infinite Being, if that be the meaning of "the Infinite," is, indeed, the highest and most perfect object of religion. But an infinite space is no object of religious feeling. An infinite number of material units is no object of religious thought. Infinite time is no object of religious thought. On the other hand, infinite power not only may be, but must be, an object of religious contemplation in proportion as it is connected with the idea of power in a living will. Infinite goodness must be the object of religious thought and emotion, because in its very nature this conception involves that of a personal being. But if all this is what is intended by "the Infinite," then it would be best to say so plainly. The only use of the phrase, as the one selected to indicate the object of religion, is that it may be understood in a sense that is kept out of sight.—ARGYLL *Unity of Nature*, ch. 11, p. 272. (Burt.)

1656. INFINITY OF SPACE, MATTER, AND ENERGY—*Science Leads Out to the Infinite.*—Infinity of space and of matter occupying space, of time and of the processes with which time is occupied, and infinity of energy as necessarily implied by the infinities of matter and of the operations affecting matter—these infinities science brings clearly before us. For science directs our thoughts to the finites to which these infinites correspond. It shows us that there can be no conceivable limits to space or time, and tho finiteness of matter or of operation may be conceivable, there is manifest incongruity in assuming an infinite disproportion between unoccupied and occupied space, or between void time and time occupied with the occurrence of events of what sort soever. So that the teachings of science bring us into the presence of the unquestionable infinities of time and of space, and the presumable infinities of matter and of operation—hence, therefore, into the presence of infinity of energy. But science teaches us nothing about these infinities, as such. They remain none the less inconceivable, however clearly we may be taught to recognize their reality.—PROCTOR *Our Place among Infinities*, p. 1. (L. G. & Co., 1897.)

1657. INFINITY REVEALED IN NATURE—The earnest and solemn thoughts awakened by a communion with Nature intuitively arise from a presentiment of the order and harmony pervading the whole universe, and from the contrast we draw between the narrow limits of our own existence and the image of infinity revealed on every side, whether we look upward to the starry vault of heaven, scan the far-stretching plain before us, or seek to trace the dim horizon across the vast expanse of ocean.—HUMBOLDT *Cosmos*, vol. i, int., p. 25. (H., 1897.)

1658. INFINITY SUGGESTED BY THE OCEAN—However much this richness [of the ocean] in animated forms, and this multitude of the most various and highly developed microscopic organisms may agreeably excite the fancy, the imagination is even more seriously, and, I might say, more solemnly moved by the impression of boundlessness and immeasurability which are presented to the mind by every sea-voyage. All who possess an ordinary degree of mental activity, and delight to create to themselves an inner world of thought, must be penetrated with the sublime image of the infinite when gazing around them on the vast and boundless sea, when involuntarily the glance is attracted to the distant horizon, where air and water blend together, and the stars continually rise and set before the eyes of the mariner. This contemplation of the eternal play of the elements is clouded, like every human joy, by a touch of sadness and of longing.—HUMBOLDT *Cosmos*, vol. i, p. 310. (H., 1897.)

1659. INFINITY, THE CONCEPTION OF—*A Necessity of Human Thought.*—"That the finite cannot comprehend the infinite" is a proposition constantly propounded as an undoubted and all-comprehensive truth. Such truth as does belong to it seems to come from the domain of physics, in which it represents the axiom that a part cannot be equal to the whole. From this, in the domain of mind, it comes to represent the truth, equally undeniable, that we cannot know all that infinity contains. But the meaning into which it is liable to pass when applied to mind is that man cannot conceive infinity. And never was any proposition so commonly accepted which, in this sense, is so absolutely devoid of all foundation. Not only is infinity conceivable by us, but it is inseparable from conceptions which

are of all others the most familiar. Both the great conceptions of space and time are, in their very nature, infinite. We cannot conceive of either of these as subject to limitation. We cannot conceive of a moment after which there shall be no more time, nor of a boundary beyond which there is no more space. This means that we cannot but think of space as infinite and of time as everlasting.—ARGYLL *Unity of Nature*, ch. 4, p. 79. (Burt.)

1660. INFIRMITY UNCONSCIOUS— *Color-blindness Only Discovered by Comparison.*—It is an interesting fact in reference to the dependence of at least one class of our knowledge on sensation, that many persons are born with defective vision and yet remain for years of their lives without being conscious of the deficiency. We know a gentleman who had probably been always near-sighted, but who did not discover the peculiarity of his vision until the age of twenty-five, when it was accidentally made known by looking at a distant object through a concave lens. Many persons whose eyes are sound and capable of exercising the most delicate functions, are permanently unable to distinguish certain colors. And the number of such persons is much more considerable than we would be led to imagine from the little attention this defect of vision has excited. It is often unknown to the individual himself, and indeed only becomes revealed by comparing his powers of discriminating different colors with those of other persons.—HENRY *Color-Blindness (Scientific Writings*, vol. i. p. 233). (Sm. Inst., 1886.)

1661. ——— ——— *Experience of a Child with Color-blindness.*—An account is given . . . of a shoemaker, in Cumberland, who could distinguish in different colors only a greater or less intensity of light, calling all bright tints white and all dull ones black. His peculiarity of vision was unknown to him until one day, while a boy, playing in the street, he found a stocking, and for the first time was struck with the fact that it was called by his companions red, whereas to his mind it was capable of no farther description than that designated by the word "stocking"; he was thus led to conclude that there was something else besides the form and position in the leaves and fruit of a cherry-tree, perceived by his playmates, but not seen by himself.—HENRY *Color-Blindness (Scientific Writings*, vol. i. p. 235). (Sm. Inst., 1886.)

1662. INFLUENCE EXERTED IN VAIN— *Air Unwarmed by Burning Solar Rays.*—On a sunny day you may see the summits of the high Alps glistening with the water of liquefaction. The air above and around the mountains may at the same time be many degrees below the freezing-point in temperature. . . . Solar beams powerful enough to fuse the snows and blister the human skin, nay, it might be added, powerful enough, when concentrated, to burn up the human body itself, may pass through the air, and still leave it at an icy temperature.—TYNDALL *Forms of Water*, pp. 100-102. (A., 1899.)

1663. INFLUENCE, FAR-REACHING, OF ONE GREAT MAN— *Roger Bacon the Scientific Light of the Middle Ages.*—In all that has directly operated on the extension of the natural sciences, and on their establishment on a mathematical basis, and by the calling forth of phenomena by the process of experiment, Roger Bacon, the cotemporary of Albertus of Bollstädt, may be regarded as the most important and influential man of the Middle Ages. These two men occupy almost the whole of the thirteenth century; but to Roger Bacon belongs the merit that the influence which he exercised on the form of the mode of treating the study of Nature has been more beneficial and lasting than the various discoveries which, with more or less justice, have been ascribed to him. Stimulating the mind to independence of thought, he severely condemned the blind faith attached to the authority of the schools, yet, far from neglecting the investigations of the ancient Greeks, he directed his attention simultaneously to philological researches, and the application of mathematics and of the *Scientia experimentalis*, to which last he devoted a special section of the "Opus Majus." Protected and favored by one pope (Clement IV.), and accused of magic and imprisoned by two others (Nicholas III. and IV.), he experienced the changes of fortune common to great minds in all ages.—HUMBOLDT *Cosmos*, vol. ii, pt. ii. p. 245. (H., 1897.)

1664. INFLUENCE FROM AFAR— *Attraction of the Sun for the Magnetic Needle.*—It had long been noticed that during the course of a single day the magnetic needle exhibits a minute change of direction, taking place in an oscillatory manner. And when the character of this vibration came to be carefully examined, it was found to correspond to a sort of effort on the needle's part to turn toward the sun. For example, when the sun is on the magnetic meridian, the needle has its mean position. This happens twice in the day, once when the sun is above the horizon, and once when he is below it. Again, when the sun is midway between these two positions—which also happens twice in the day—the needle has its mean position, because the northern and the southern ends make equal efforts, so to speak, to direct themselves toward the sun. Four times in the day, then, the needle has its mean position, or is directed toward the magnetic meridian. But when the sun is not in one of the four positions considered, that end of the needle which is nearest to him is slightly turned away from its mean position, toward him. The change of position is very minute, and only the exact methods of observation made use of in the present age would have sufficed to reveal it.

There it is, however, and this minute and seemingly unimportant peculiarity has been found to be full of meaning.—PROCTOR *Other Worlds than Ours*, ch. 2, p. 41. (Burt.)

1665. INFLUENCE, MYSTERIOUS, OF THE SUN ON THE MAGNETIC NEEDLE—*Correspondence of Oscillations of the Needle with Sun-spots.*—The amplitude of these diurnal oscillations [of the magnetic needle] varies every day, every month, every year. If we take the mean of the observations for a whole year, we ascertain that this oscillation may lengthen from single to double in a period of about 11 years, which period—a fact eminently worthy of attention—corresponds to that of the solar spots, *the maximum of the oscillations coinciding with the maximum of the spots, and the minimum with the minimum!* All the other elements of magnetism, inclination, and intensity show the same relation. Further, the magnetic needle manifests from time to time abnormal variations, perturbations caused by magnetic storms; *these perturbations also coincide with the great agitations observed in the sun!*—FLAMMARION *Popular Astronomy*, bk. iii, ch. 5, p. 288. (A.)

1666. INFLUENCE OF AN ENLIGHTENED MONARCH—*Ornithology Encouraged by Queen Isabella.*—Columbus brought home from his first voyage of discovery some natural products, as, for instance, fruits and the skins of animals. In a letter written from Segovia (August, 1494), Queen Isabella enjoins on the admiral to persevere in his collections; and she especially requires of him that he should bring with him specimens of "all the coast and forest birds peculiar to countries which have a different climate and different seasons."—HUMBOLDT *Cosmos*, vol. ii, pt. ii, p. 274. (H., 1897.)

1667. INFLUENCE OF CULTIVATION—*Evolution of the Cabbage—Cause Still To Seek—Plants that Stubbornly Resist Improvement.*—There is no more remarkable example of the alteration produced by more abundant supply of food and more regulated temperature than that exhibited in the development of the wild *Brassica oleracea*, a rambling seashore plant, into the various kinds of cabbage, broccoli, and cauliflower. Why will not culture produce the like effect upon other plants? It is quite illogical to say that this transformation has been the effect of "physical causes," when the most essential factor in that entire "aggregate of antecedents," which (according to J. S. Mill) constitutes the "cause," is the "unknown quantity" which we designate as the "constitution" of the organism itself. As I have already pointed out, we do not get any nearer to the explanation of this constitution by tracing it backwards ancestrally; for supposing *Rosa*, *Rubus*, *Salix*, and *Brassica* to have derived their respective peculiarities by "natural selection" from among previous varieties, the question recurs, Whence those varietal modifications? No physical agencies can be assigned, at any stage whatever of the descent, as an adequate account of them; since, for those agencies to take effect there must have been a concurrent capacity for variation, either in the organism itself or in its germ, in virtue of which its varietal forms were engendered. The necessity for this factor is evinced by the negative results of its deficiency, shown in the "rareness" of many wild plants, and the unconquerable resistance made by others to all improvement by cultivation.—CARPENTER *Nature and Man*, lect. 15, p. 437. (A., 1889.)

1668. INFLUENCE OF GEOGRAPHIC CONDITIONS ON HISTORY—This triple constriction of the Mediterranean [into Ægean, Syrtic, and Tyrrhenian basins] has exercised a great influence on the earliest limitations and the subsequent extension of Phenician and Greek voyages of discovery. The latter were long limited to the Ægean and Syrtic seas. In the Homeric times the continent of Italy was still an "unknown land." The Phocæans opened the Tyrrhenian basin west of Sicily, and Tartessian mariners reached the Pillars of Hercules. It must not be forgotten that Carthage was founded at the boundary of the Tyrrhenian and Syrtic basins. The physical configuration of the coast line influenced the course of events, the direction of nautical undertakings, and the changes in the dominion of the sea; and the latter reacted again on the enlargement of the sphere of ideas.—HUMBOLDT *Cosmos*, vol. ii, pt. ii, p. 120. (H., 1897.)

1669. INFLUENCE OF HEAT AND COLD ON WATER—*Ice Lighter than Water.*—Like almost all other substances, water is expanded by heat and contracted by cold. . . . A small flask is filled with colored water and stopped with a cork. Through the cork passes a glass tube, water-tight, the liquid standing at a certain height in the tube. The flask and its tube resemble the bulb and stem of a thermometer. Applying the heat of a spirit-lamp, the water rises in the tube and finally trickles over the top. Expansion by heat is thus illustrated. Removing the lamp and piling a freezing mixture round the flask the liquid column falls, thus showing the contraction of the water by the cold. But let the freezing mixture continue to act, the falling of the column continues to a certain point; it then ceases. The top of the column remains stationary for some seconds, and afterwards begins to rise. The contraction has ceased, and expansion by cold sets in. Let the expansion continue till the liquid trickles a second time over the top of the tube. The freezing mixture has here produced to all appearance the same effect as the flame. In the case of water, contraction by cold

ceases and expansion by cold sets in at the definite temperature of 39° F. Crystallization has virtually here commenced, the molecules preparing themselves for the subsequent act of solidification which occurs at 32°, and in which the expansion suddenly culminates. In virtue of this expansion, ice, as you know, is lighter than water in the proportion of 8 to 9.—TYNDALL *Lectures on Light*, lect. 3, p. 107. (A., 1898.)

1670. INFLUENCE OF NATURE ON POETRY—*Cicero's Descriptions True to Fact.*—In Cicero's smaller sketches of Nature we find, as has been remarked, all things described as they still exist in the actual landscape; we see the Liris shaded by lofty poplars; and as we descend from the steep mountain behind the old towers of Arpinum we see the grove of oaks on the margin of the Fibrenus, and the island now called Isola di Carnello, which is formed by the division of the stream, and whither Cicero retired in order, as he said, to "give himself up to meditation, reading, and writing." Arpinum, situated on the Volscian Hills, was the birthplace of the great statesman, and its noble scenery no doubt exercised an influence on his character in boyhood. Unconsciously to himself the external aspect of the surrounding scenery impresses itself upon the soul of man with an intensity corresponding to the greater or less degree of his natural susceptibility, and becomes closely interwoven with the deep original tendencies and the free natural disposition of his mental powers.—HUMBOLDT *Cosmos*, vol. ii, pt. i, p. 31. (H., 1897.)

1671. INFLUENCE TRANSMITTED—*Color-photography—Telephone and Phonograph.*—The principle [of color-photography] is the same for the light-waves as that of the telephone for sound-waves. The voice sets up vibrations in the transmitting diaphragm, which by means of an electric current are so exactly reproduced in the receiving diaphragm as to give out the same succession of sounds. An even more striking and perhaps closer analogy is that of the phonograph, where the vibrations of the diaphragm are permanently registered on a wax cylinder, which at any future time can be made to set up the same vibrations of the air, and thus reproduce the same succession of sounds, whether words or musical notes.—WALLACE *The Wonderful Century*, ch. 5, p. 36. (D. M. & Co., 1899.)

1672. INGENUITY OF A SPIDER—*Web Stayed by Suspended Weight.*—J. G. Wood ("Glimpses into Petland") [relates the following incident]: "One of my friends," says Wood, "was accustomed to grant shelter to a number of garden spiders under a large veranda, and to watch their habits. One day a sharp storm broke out and the wind raged so furiously through the garden that the spiders suffered damage from it, altho sheltered by the veranda. The main-yards of one of these webs, as the sailors would call them, were broken, so that the web was blown hither and thither like a slack sail in a storm. The spider made no fresh threads, but tried to help itself in another way. It let itself down to the ground by a thread and crawled to a place where lay some splintered pieces of a wooden fence thrown down by the storm. It fastened a thread to one of the bits of wood, turned back with it, and hung it with a strong thread to the lower part of its nest, about five feet from the ground. The performance was a wonderful one, for the weight of the wood sufficed to keep the nest tolerably firm, while it was yet light enough to yield to the wind and so prevent further injury. The piece of wood was about two and a half inches long and as thick as a goose-quill. On the following day a careless servant knocked her head against the wood and it fell down. But in the course of a few hours the spider had found it and brought it back to its place. When the storm ceased the spider mended her web, broke the supporting thread in two, and let the wood fall to the ground!"—ROMANES *Animal Intelligence*, ch. 6, p. 221. (A., 1899.)

1673. INGENUITY OF PRIMITIVE MAN—*Picks Made of Deer's Horns.*—The implements used in making these excavations were deer's horns, the brow tine being used as a pick, and the others removed. Thus treated, a deer's horn closely resembles in form a modern pick, but of course it is subject to rapid wear by use, which accounts for the large numbers of worn-out implements found by Mr. Greenwell among the rubbish.—AVEBURY *Prehistoric Times*, ch. 4, p. 79. (A., 1900.)

1674. INGRATITUDE—*The Sun an Unrecognized Benefactor—Unappreciated Beneficence.*—The sun is an emblem of the Almighty in the manner in which he bestows benefits upon us and is forgotten. Day after day we enjoy the sun's light and heat; clouds may conceal him from our view, much as troubles may cause us to forget God: and the heat he pours out may seem sometimes insufficient or excessive, even as in our ignorance we are dissatisfied with the blessings bestowed by the Almighty.—PROCTOR *Expanse of Heaven*, p. 12. (L. G. & Co., 1897.)

1675. INHERITANCE OF MENTAL DISEASE—*Insanity in Royal Families.*—It is in reigning families that mental disorders are hereditary in an unusual degree. Thus Esquirol, distinguished for his knowledge of mental diseases, proved that the number of insane individuals in the reigning houses was, in proportion to the number among the ordinary population, as 60 to 1; that is, that disorders of the brain occur 60 times more frequently in the privileged families of the ruling houses than among ordinary people. This phenomenon can scarcely astonish us when we consider what injury these privileged castes inflict upon them-

selves by their unnatural, one-sided education, and by their artificial separation from the rest of mankind. By this means many dark sides of human nature are specially developed and, as it were, artificially bred, and according to the laws of transmission by inheritance are propagated through series of generations with ever-increasing force and dominance.—HAECKEL *History of Creation*, vol. i, ch. 8, p. 186. (K. P. & Co., 1899.)

1676. INHERITANCE THE RULE— *Non-inheritance the Anomaly.*—If strange and rare deviations of structure are really inherited, less strange and commoner deviations may be freely admitted to be inheritable. Perhaps the correct way of viewing the whole subject would be to look on the inheritance of every character whatever as the rule, and non-inheritance as the anomaly. [See also HEREDITY.]—DARWIN *Origin of Species*, ch. 1, p. 12. (Burt.)

1677. INHERITANCE THROUGH COUNTLESS GENERATIONS—*Bobolink of Utah Follows Ancestral Path Southward.*—Existing conditions [of bird-migration] are the result of changes which have been active for ages. No species, therefore, has acquired its present summer range at one step, but by gradually adding new territory to its breeding-ground. For example, certain of our Eastern birds are evidently derived through Mexico, and in returning to their winter quarters in Central America they travel through Texas and Mexico, and are unknown in Florida and the West Indies. Others have come to us through Florida, and in returning to their winter quarters do not pass through either Texas or Mexico. This is best illustrated by the bobolink, an Eastern bird which, breeding from New Jersey northward to Nova Scotia, has spread westward until it has reached Utah and northern Montana. But—and here is the interesting point—these birds of the Far West do not follow their neighbors and migrate southward through the Great Basin into Mexico, but, true to their inherited habit, retrace their steps and leave the United States by the roundabout way of Florida, crossing thence to Cuba, Jamaica, and Yucatan, and wintering south of the Amazon. The bobolinks of Utah did not learn this route in one generation; they inherited the experience of countless generations, slowly acquired as the species extended its range westward, and in returning across the continent they give us an excellent illustration of the stability of routes of migration.—CHAPMAN *Bird-Life*, ch. 4, p. 60. (A., 1900.)

1678. INHUMANITY AMID PERIL AND SUFFERING—*Robbers Plunder Victims of Earthquake.*—It is supposed that [in the great Calabrian earthquake, 1783] about a fourth part of the inhabitants of Polistina, and of some other towns, were buried alive, and might have been saved had there been no want of hands; but in so general a calamity, where each was occupied with his own misfortunes or those of his family, aid could rarely be obtained. Neither tears nor supplications nor promises of high rewards were listened to. Many acts of self-devotion, prompted by parental and conjugal tenderness, or by friendship or the gratitude of faithful servants, are recorded; but individual exertions were, for the most part, ineffectual. It frequently happened that persons in search of those most dear to them could hear their moans, could recognize their voices, were certain of the exact spot where they lay buried beneath their feet, yet could afford them no succor. The piled mass resisted all their strength and rendered their efforts of no avail.

At Terranuova four Augustin monks, who had taken refuge in a vaulted sacristy, the arch of which continued to support an immense pile of ruins, made their cries heard for the space of four days. One only of the brethren of the whole convent was saved, and "of what avail was his strength to remove the enormous weight of rubbish which had overwhelmed his companions"? He heard their voices die away gradually, and when afterwards their four corpses were disinterred they were found clasped in each other's arms. Affecting narratives are preserved of mothers saved after the fifth, sixth, and even seventh day of their interment, when their infants or children had perished with hunger.

It might have been imagined that the sight of sufferings such as these would have been sufficient to awaken sentiments of humanity and pity in the most savage breasts; but while some acts of heroism are related, nothing could exceed the general atrocity of conduct displayed by the Calabrian peasants; they abandoned the farms and flocked in great numbers into the towns—not to rescue their countrymen from a lingering death, but to plunder. They dashed through the streets, fearless of danger, amid tottering walls and clouds of dust, trampling beneath their feet the bodies of the wounded and half-buried, and often stripping them, while yet living, of their clothes.—LYELL *Principles of Geology*, bk. ii, ch. 28, p. 491. (A., 1854.)

1679. INITIATIVE, DESTRUCTION OF—*Cutting Off Cerebral Hemispheres of Frog—Animal Becomes Automatic Machine.*—When a frog's cerebral hemispheres alone are cut off by a section between them and the thalami, which preserves the latter, an unpractised observer would not at first suspect anything abnormal about the animal. Not only is he capable, on proper instigation, of all the acts already described [of ordinary life], but he guides himself by sight, so that if an obstacle be set up between him and the light, and he be forced to move forward, he either jumps over it or swerves to one side. . . . Thus far, as aforesaid, a person unfamiliar with frogs might not suspect a mutilation; but even such a person would

soon remark the almost entire absence of spontaneous motion—that is, motion unprovoked by any present incitation of sense. The continued movements of swimming performed by the creature in the water seem to be the fatal result of the contact of that fluid with its skin. They cease when a stick, for example, touches his hands. This is a sensible irritant towards which the feet are automatically drawn by reflex action, and on which the animal remains sitting. He manifests no hunger and will suffer a fly to crawl over his nose unsnapped at. Fear, too, seems to have deserted him. In a word, he is an extremely complex machine whose actions, so far as they go, tend to self-preservation; but still a machine, in this sense—that it seems to contain no incalculable element. By applying the right sensory stimulus to him we are almost as certain of getting a fixed response as an organist is of hearing a certain tone when he pulls out a certain stop.—JAMES *Psychology*, vol. i, ch. 2, p. 17. (H. H. & Co., 1899.)

1680. INJURY BY INDIRECTION—*Products of Bacteria More Harmful than the Organisms Themselves—Toxins.*—Yet there is something of far greater importance than the mere presence of bacteria in human or animal tissues; for the secondary action of disease-producing germs—and possibly it is present in all bacteria—is due to their poisonous products, or toxins, as they have been termed. These may be of the nature of ferments, and they become diffused throughout the body, whether the bacteria themselves occur locally or generally. They may bring about very slight and even imperceptible changes during the course of the disease, or they may kill the patient in a few hours. Latterly bacteriologists have come to understand that it is not so much the presence of organisms which is injurious to man and other animals, as it is their products which cause the mischief; and the amount of toxic product bears no known proportion to the degree of invasion by the bacteria. The various and widely differing modes of action in bacteria are therefore dependent upon these three elements: the tissues or medium, the bacteria, and the products of the bacteria; and in all organismal processes these three elements act and react upon each other.—NEWMAN *Bacteria*, ch. 1, p. 28. (G. P. P., 1899.)

1681. INSANITY, MORAL, MAY BE CONGENITAL—*Children of Better Classes Sometimes Hopelessly Depraved.*—From time to time we are consulted about perplexing cases of what might be called moral insanity, or, more properly, moral imbecility, in children of the better classes. Tho born in good circumstances of life and having every advantage of education, they cannot, by any care or training, be made to learn and behave like other children; they display no affection whatever for parents, brothers, or sisters, and no real appreciation of the difference between right and wrong—no love for the one, no remorse for the other; they are inherently vicious, and steal and lie with a skill that it is hard to believe could ever have been acquired—are, in fact, instinctive thieves and liars; everything that their vicious nature prompts them to desire is for them right, and they exhibit a remarkable cunning in gratifying their evil propensities; they are the hopeless pupils of any master who has anything to do with them, and are sure to be expelled from any school to which they may be sent. In the end all those who have to do with them are constrained to ascribe to defect what at first seemed simple badness. Now, what we commonly find in these cases, when we are able to push satisfactory inquiry into their hereditary antecedents, is that they come of families in which insanity or some allied neurosis prevails.—MAUDSLEY *Body and Mind*, lect. 4, p. 111. (A., 1898.)

1682. INSECT WITH BIRD-LIKE HABIT—*Wasp Feeding Its Young.*—Its [the *Monedula* wasp's] singular habits and intelligence give it a still better claim to notice. It is a big, showy, loud-buzzing insect, with pink head and legs, wings with brown reflections, and body encircled with alternate bands of black and pale gold, and has a preference for large composite flowers, on the honey of which it feeds. Its young is, however, an insect-eater; but the *Monedula* does not, like other burrowing or sand wasps, put away a store of insects or spiders, partially paralyzed, as a provision for the grub till it reaches the pupa state; it actually supplies the grub with fresh-caught insects as long as food is required, killing the prey it captures outright, and bringing it in to its young, so that its habits, in this particular, are more bird- than wasp-like.—HUDSON *Naturalist in La Plata*, ch. 12, p. 163. (C. & H., 1895.)

1683. INSECT-LIFE, RICHNESS OF, IN TROPICS—*Number and Splendor of Butterflies in Brazil—Luxuriance of Beauty in Wilderness.*—It will convey some idea of the diversity of butterflies when I mention that about 700 species of that tribe are found within an hour's walk of the town [Para], while the total number found in the British Islands does not exceed 66, and the whole of Europe supports only 321. Some of the most showy species, such as the swallow-tailed kinds, *Papilio polycaon*, *thoas*, *torquatus*, and others, are seen flying about the streets and gardens; sometimes they come through the open windows, attracted by flowers in the apartments. Those species of *Papilio* which are most characteristic of the country, so conspicuous in their velvety-black, green and rose-colored hues, which Linnæus, in pursuance of his elegant system of nomenclature—naming the different kinds after the heroes of Greek mythology—called Trojans, never leave the shades of the forest. The splendid metallic blue

morphos, some of which measure seven inches in expanse, are generally confined to the shady valleys of the forest. They sometimes come forth into the broad sunlight. When we first went to look at our new residence in Nazareth a *Morpho menelaus*, one of the most beautiful kinds, was seen flapping its huge wings like a bird along the veranda. This species, however, altho much admired, looks dull in color by the side of its congener, the *Morpho rhetenor*, whose wings, on the upper face, are of quite a dazzling luster.—BATES *Naturalist on the River Amazon*, ch. 3, p. 643. (Hum., 1880.)

1684. INSECTS, ACUTE SENSES OF —*Bees, Butterflies, and Wasps Guided by Sight or Scent.*—That bees and butterflies have this power [of distinguishing between colors] is manifest. They may be watched flying from flower to flower, disregarding all other parts of the plants. . . . Odors, like colors, draw insects to flowers. After observing how bees come swarming into a house where honey is largely exposed, or how wasps find their way into a shop containing much ripe fruit, it cannot be questioned that insects are to a considerable extent guided by scent. Being thus sensitive to the aromatic substances which flowers exhale, they may, when the flowers are in large masses, be attracted by them from distances at which the flowers themselves are invisible.—SPENCER *Biology*, pt. v, ch. 3, p. 268. (A., 1900.)

1685. INSECTS, CAPTURE OF, BY SUNDEW—*Tentacles of Leaf Close as if by Design upon Victim—Action Irresistible of Natural Mechanism.*—When an insect alights on the central disk [of the sundew leaf], it is instantly entangled by the viscid secretion, and the surrounding tentacles after a time begin to bend, and ultimately clasp it on all sides. Insects are generally killed, according to Dr. Nitschke, in about a quarter of an hour, owing to their tracheæ being closed by the secretion. If an insect adheres to only a few of the glands of the exterior tentacles, these soon become inflected and carry their prey to the tentacles next succeeding them inwards; these then bend inwards, and so onwards, until the insect is ultimately carried by a curious sort of rolling movement to the center of the leaf. Then, after an interval, the tentacles on all sides become inflected and bathe their prey with their secretion, in the same manner as if the insect had first alighted on the central disk. It is surprising how minute an insect suffices to cause this action: for instance, I have seen one of the smallest species of gnats (*culex*), which had just settled with its excessively delicate feet on the glands of the outermost tentacles, and these were already beginning to curve inwards, tho not a single gland had as yet touched the body of the insect. Had I not interfered, this minute gnat would assuredly have been carried to the center of the leaf and been securely clasped on all sides.—DARWIN *Insectivorous Plants*, ch. 1, p. 13. (A., 1900.)

1686. INSECTS FERTILIZING FLOWERS—*Horticulturist Aided by Science —The Smyrna Fig Culture Made Possible in the United States.*—That an article bearing this title ["Smyrna Fig Culture in the United States"] should be prepared by an entomologist may seem at first glance unusual, not to say curious; but as is well known to those informed on the subject, and as will be readily seen by the readers of this article, the problem of establishing the Smyrna fig industry in the United States has been very largely an entomological problem. . . . Since time immemorial it has been known that in Oriental regions it has been the custom of the natives to break off the fruits of the capifig, bring them to the edible-fig trees, and tie them to the limbs. From the caprifigs thus brought in there issues a minute insect, which, covered with pollen, crawls into the flower receptacles of the edible fig, fertilizes them, and thus produces a crop of seeds and brings about the subsequent ripening of the fruit. . . . In the caprifig there is said to exist in Mediterranean regions three crops of fruit—the spring crop, known as "profichi," the second as "mammoni," and the third as "mamme," the latter remaining upon the trees through the winter. The fig insects (the Oriental species being known as *Blastophaga grossorum*, Gravenhorst) overwinter in the mamme, oviposit in the profichi, develop a generation within it, each individual living in the swelling of a gall-flower (a modified and infertile female flower), and issue from it covered with pollen, enter the young flower-receptacles of the Smyrna fig, which are at that time of the proper size, and make an attempt to oviposit in the true female flowers, fertilizing them at the same time by means of the pollen adhering to their bodies.

[As the result of the researches and experiments of the Entomological Division of the Department of Agriculture, this insect (the *Blastophaga*) has now been naturalized in California, so that in the year 1899-1900 more than six tons of edible figs were prepared for market, as the result of the insect-life contained in less than 450 winter figs, where previously the fruit of thrifty Smyrna fig-trees had always fallen and perished while immature.]
—HOWARD *Smyrna Fig Culture in the United States (Year-book of the Department of Agriculture, 1900*, pp. 79-106.)

1687. ——— ——— *Profitable Result of Scientific Experiments—A Great Industry Resulting from Microscopic Research.*—Chemical analysis made by Professor Hilgard, of the University of California, showed that figs submitted to him by Mr. Roeding contained 1.42 per cent. more sugar than the best imported Smyrna figs. Samples which the writer has received are of excep-

tional edibility. The flavor is delicious and precisely comparable to that of the imported figs, except for the lack of the slight acidity noticed in those ordinarily bought on the market, and which is of a rather disagreeable quality. Wholesale grocers to whom the writer has shown samples speak with strong approval of their quality, and there seems little doubt that a great and profitable trade in figs of this grade can readily be gained in the United States. . . . But this feature by no means comprises all the possibilities of the industry. America will compete with the Mediterranean countries in the open markets of the world. The character of the product, even of this first year's crop, shows it to be superior to the Oriental product, both from chemical analysis and from expert opinion. . . . Cleanliness in packing, prevention of the disgusting worms so often found in the imported Smyrna figs, and other similar points will be carefully attended to by American packers. . . . The right varieties [of trees] will be planted by the thousands during the coming year, and in four or five years will be producing substantial crops. [See FIG, SMYRNA.]—HOWARD *Smyrna Fig Culture in the United States (Year-book of the Department of Agriculture, 1900*, pp. 79-106).

1688. INSECTS FLEEING BEFORE WIND—*Dragon-flies and the Pampero.*—The pampero is a dry, cold wind, exceedingly violent. It bursts on the plains very suddenly, and usually lasts only a short time, sometimes not more than ten minutes; it comes irregularly, and at all seasons of the year, but is most frequent in the hot season, and after exceptionally sultry weather. It is in summer and autumn that the large dragon-flies appear; not with the wind, but —and this is the most curious part of the matter—in advance of it; and inasmuch as these insects are not seen in the country at other times, and frequently appear in seasons of prolonged drought, when all the marshes and watercourses for many hundreds of miles are dry, they must of course traverse immense distances, flying before the wind at a speed of seventy or eighty miles an hour. On some occasions they appear almost simultaneously with the wind, going by like a flash, and instantly disappearing from sight. You have scarcely time to see them before the wind strikes you.—HUDSON *Naturalist in La Plata*, ch. 9, p. 131. (C. & H., 1895.)

1689. INSECURITY, SENSE OF, PRODUCED BY EARTHQUAKE—*The "Solid Ground" Quivers Like Thin Ice.*—February 20th, 1835.—This day has been memorable in the annals of Valdivia for the most severe earthquake experienced by the oldest inhabitant. I happened to be on shore, and was lying down in the wood to rest myself. It came on suddenly, and lasted two minutes, but the time appeared much longer. The rocking of the ground was very sensible. The undulations appeared to my companion and myself to come from due east, whilst others thought they proceeded from southwest: this shows how difficult it sometimes is to perceive the direction of the vibrations. There was no difficulty in standing upright, but the motion made me almost giddy: it was something like the movement of a vessel in a little cross-ripple, or still more like that felt by a person skating over thin ice, which bends under the weight of his body. A bad earthquake at once destroys our oldest associations: the earth, the very emblem of solidity, has moved beneath our feet like a thin crust over a fluid—one second of time has created in the mind a strange idea of insecurity, which hours of reflection would not have produced.—DARWIN *Naturalist's Voyage around the World*, ch. 14, p. 301. (A., 1898.)

1690. INSENSIBILITY DUE TO ABSENCE OF MIND—*Power of Mental Absorption over the Bodily Life.*—Archimedes, it is well known, was so absorbed in geometrical meditation that he was first aware of the storming of Syracuse by his own death-wound, and his exclamation on the entrance of the Roman soldiers was: *Noli turbare circulos meos!* In like manner Joseph Scaliger, the most learned of men, when a Protestant student in Paris was so engrossed in the study of Homer that he became aware of the massacre of St. Bartholomew, and of his own escape, only on the day subsequent to the catastrophe. The philosopher Carneades was habitually liable to fits of meditation so profound that, to prevent him sinking from inanition, his maid found it necessary to feed him like a child. And it is reported of Newton that, while engaged in his mathematical researches, he sometimes forgot to dine. Cardan, one of the most illustrious of philosophers and mathematicians, was once, upon a journey, so lost in thought that he forgot both his way and the object of his journey. To the questions of his driver whether he should proceed, he made no answer; and when he came to himself at nightfall, he was surprised to find the carriage at a standstill, and directly under a gallows. The mathematician Vieta was sometimes so buried in meditation that for hours he bore more resemblance to a dead person than to a living, and was then wholly unconscious of everything going on around him. On the day of his marriage the great Budæus forgot everything in his philological speculations, and he was only awakened to the affairs of the external world by a tardy embassy from the marriage-party, who found him absorbed in the composition of his "Commentarii."—HAMILTON *Metaphysics*, lect. 14, p. 180. (G. & L., 1859.)

1691. INSIGHT, SCIENTIFIC, ENLARGED—*Mental Advance Attends Opening of the Pacific.*—The Sandwich Islands, Papua or New Guinea, and some portions of

New Holland were all discovered in the early half of the sixteenth century. . . . The Pacific no longer appeared as it had done to Magellan, a desert waste; it was now animated by islands, which, however, for want of exact astronomical observations, appeared to have no fixed position, but floated from place to place over the charts. The Pacific remained for a long time the exclusive theater of the enterprises of the Spaniards and Portuguese. It was not until the Dutch power acquired the ascendency in the Moluccas that Australia began to emerge from its former obscurity and to assume a definite form in the eyes of geographers. In a short space of time and in continuous connection, two-thirds of the earth's surface were opened to the apprehension of men, in consequence of the suddenly awakened desire to reach the wide, the unknown, and the remote regions of our globe.

An enlarged insight into the nature and the laws of physical forces, into the distribution of heat over the earth's surface, the abundance of vital organisms and the limits of their distribution, was developed simultaneously with this extended knowledge of land and sea.—HUMBOLDT *Cosmos*, vol. ii, pt. ii. p. 272. (H., 1897.)

1692. INSPIRATION NEEDED IN SCIENCE—*Knowledge Supplemented by Reflection.*—In his efforts to cross the common bourn of the known and the unknown, the effective force of the man of science must depend, to a great extent, upon his acquired knowledge. But knowledge alone will not do; a stored memory will not suffice; inspiration must lend its aid. Scientific inspiration, however, is usually, if not always, the fruit of long reflection—of patiently "intending the mind," as Newton phrased it, and as Copernicus, Newton, and Darwin practised it, until outer darkness yields a glimmer, which in due time opens out into perfect intellectual day.—TYNDALL *Fragments of Science,* vol. i, ch. 5, p. 132. (A., 1897.)

1693. INSPIRATION OF GENIUS—*Compared to the Gift of the Spirit (John iii. 8)—The Joy of Discovery—The "Eureka" of Archimedes.*—Working backwards from a limited number of phenomena, genius, by its own expansive force, reaches a conception which covers them all. There is no more wonderful performance of the intellect than this; but we can render no account of it. Like the Scriptural gift of the Spirit, no man can tell whence it cometh. The passage from fact to principle is sometimes slow, sometimes rapid, and at all times a source of intellectual joy. When rapid, the pleasure is concentrated and becomes a kind of ecstasy or intoxication. To any one who has experienced this pleasure, even in a moderate degree, the action of Archimedes when he quitted the bath, and ran naked, crying "Eureka!" through the streets of Syracuse, becomes intelligible.—TYNDALL *Lectures on Light,* lect. 2, p. 47. (A., 1898.)

1694. INSTABILITY OF THE EARTH—*The Eruption of Krakatoa Felt around the Globe—The Dust Thrown into the Atmosphere Would Bury Washington Monument.*—The eruption of Krakatoa occurred in 1883, and it will be remembered the air-wave started by the explosion was felt around the globe, and that probably owing to the dust and water-vapor blown into the atmosphere, the sunsets even in America became of that extraordinary crimson we all remember [as occurring at that time]; and, coincidently, that dim reddish halo made its appearance about the sun the world over. . . . Very careful estimates of the amount of ashes ejected have been made; and tho most of the heavier particles are known to have fallen into the sea within a few miles, a certain portion—the lightest—was probably carried by the explosion far above the lower strata of the atmosphere, to descend so slowly that some of it may still be there. Of this lighter class the most careful estimates must be vague; but according to the report of the official investigation by the Dutch Government, that which remained floating is something enormous. An idea of its amount may be gained by supposing these impalpable and invisible particles to condense again from the upper sky, and to pour down on the highest edifice in the country, the Washington Monument. If the dust were allowed to spread out on all sides, till the pyramidal slope was so flat as to be permanent, the capstone of the monument would not only be buried before the supply was exhausted, but buried as far below the surface as that pinnacle is now above it.—LANGLEY *New Astronomy,* ch. 6, p. 181. (H. M. & Co., 1896.)

1695. INSTINCT AND REASON—*Human Organism Like Keyed Instrument—Lower Animal Like Barrel-organ—Caterpillar and Its Hammock.*—Thus, then, while the human organism may be likened to a keyed instrument, from which any music it is capable of producing can be called forth at the will of the performer, we may compare a bee or any other insect to a barrel-organ, which plays with the greatest exactness a certain number of tunes that are set upon it, but can do nothing else. The following fact, mentioned by Pierre Huber, affords a curious example of the purely automatic nature of instinctive action:

There is a caterpillar that makes a very complicated hammock, the construction of which may be divided into six stages. One of these caterpillars which had completed its own hammock, having been transferred to another carried only to its third stage, completed this also by reperforming the fourth, fifth, and sixth stages. But another caterpillar taken out of a hammock which had been only carried to its third stage, and put into one already completed, appeared much embarrassed, and seemed forced to go back to the point at which it had itself left off, executing anew the fourth, fifth, and

sixth stages which had been already wrought out.—CARPENTER *Mental Physiology*, bk. i, ch. 2, p. 61. (A., 1900.)

1696. INSTINCT DYING OF INANITION—*Men without the Desire of Hunting.*—The latter [hunting] instinct is easily restricted by habit to certain objects, which become legitimate "game," while other things are spared. If the hunting instinct be not exercised at all, it may even entirely die out, and a man may enjoy letting a wild creature live, even tho he might easily kill it. Such a type is now becoming frequent. —JAMES *Psychology*, vol. ii, ch. 24, p. 415. (H. H. & Co., 1899.)

1697. INSTINCT FOLLOWS INFLEXIBLE ROUTINE—*The Sphex-wasp.*—The butcher-wasps paralyze their prey [that it may become food for their larvæ]. Fabre removed from a so-called sphex-wasp a killed grasshopper, which it was conveying to its nest and had momentarily laid down at the mouth of the burrow—as these insects always do on returning with prey, in order to see that nothing has intruded into the burrow during their absence. Fabre carried the dead or paralyzed grasshopper to a considerable distance from the hole. On coming out the insect searched about until it found its prey. It then again carried it to the mouth of its burrow, and again laid it down while it once more went in to see that all was right at home. Again Fabre removed the grasshopper, and so on for forty times in succession—the sphex never omitting to go through its fixed routine of examining the interior of its burrow every time that it brought the prey to its mouth.—ROMANES *Animal Intelligence*, ch. 4, p. 181. (A., 1899.)

1698. INSTINCT INDEPENDENT OF EDUCATION—*Automatic Adaptation to Ends.*—Instinct is usually defined as the faculty of acting in such a way as to produce certain ends, without foresight of the ends, and without previous education in the performance. That instincts, as thus defined, exist on an enormous scale in the animal kingdom needs no proof. They are the functional correlatives of structure. With the presence of a certain organ goes, one may say, almost always a native aptitude for its use. [In his work on "Instinct," P. A. Chadbourne says]:

"Has the bird a gland for the secretion of oil? She knows instinctively how to press the oil from the gland, and apply it to the feather. Has the rattlesnake the grooved tooth and gland of poison? He knows without instruction how to make both structure and function most effective against his enemies. Has the silkworm the function of secreting the fluid silk? At the proper time she winds the cocoon such as she has never seen, as thousands before have done, and thus, without instruction, pattern, or experience, forms a safe abode for herself in the period of transformation. Has the hawk talons? She knows by instinct how to wield them effectively against the helpless quarry."—JAMES *Psychology*, vol. ii, ch. 24, p. 383. (H. H. & Co., 1899.)

1699. INSTINCT IN MAN—*Existing, but Controlled.*—It is often said that man is distinguished from the lower animals by having a much smaller assortment of native instincts and impulses than they, but this is a great mistake. . . . If we compare him with the mammalia, we are forced to confess that he is appealed to by a much larger array of objects than any other mammal; that his reactions on these objects are characteristic and determinate in a very high degree. The monkeys, and especially the anthropoids, are the only beings that approach him in their analytic curiosity and width of imitativeness. His instinctive impulses, it is true, get overlaid by the secondary reactions due to his superior reasoning power; but thus man loses the simply instinctive demeanor. But the life of instinct is only disguised in him, not lost.—JAMES *Talks to Teachers*, ch. 6, p. 43. (H. H. & Co., 1900.)

1700. ——— ——— *Less Imperious than in the Inferior Animals—Differences Exceed Resemblances—The Migrating Impulse.*—To measure the differences between beast and man is really more difficult than tracing their resemblances. One plain mark of the higher intellectual rank of man is that he is less dependent on instinct than the animals which migrate at a fixed season, or build nests of a fixed and complicated pattern peculiar to their kind. Man has some instincts plainly agreeing with those of inferior animals, such as the child's untaught movements to ward off danger, and the parental affection which preserves the offspring during the first defenseless period of life. But if man were possessed by a resistless longing to set off wandering southward before winter, or to build a shelter of boughs laid in a particular way, this would be less beneficial to his species than the use of intelligent judgment adapting his actions to climate, supply of food, danger from enemies, and a multitude of circumstances differing from district to district, and changing from year to year.—TYLOR *Anthropology*, ch. 2, p. 50. (A., 1899.)

1701. INSTINCT, LIMITATIONS OF—*Bees Know Locality Rather than Hive.*—Mr. George Turner found that when he removed a beehive only a yard or two from its accustomed site, the bees, on returning home, flew in swarms around the latter, and for a long time were unable to find the hive. And several other similar cases might be adduced. Lastly, Thompson says:

It is highly remarkable that they [bees] know their hive more from its locality than from its appearance, for, if it be removed during their absence and a similar one be substituted, they enter the strange one. If the position of a hive be changed, the bees

for the first day take no distant flight till they have thoroughly scrutinized every object in its neighborhood.—ROMANES *Animal Intelligence*, ch. 4, p. 149. (A., 1899.)

1702. ——— ——— *Dog Tries To Bury Food under Carpet—Automatic Action without Purpose—Transitoriness of Impulse.*—I have observed a Scotch terrier, born on the floor of a stable in December, and transferred six weeks later to a carpeted house, make, when he was less than four months old, a very elaborate pretense of burying things, such as gloves, etc., with which he had played till he was tired. He scratched the carpet with his forefeet, dropped the object from his mouth upon the spot, and then scratched all about it (with both fore- and hind-feet, if I remember rightly), and finally went away and let it lie. Of course the act was entirely useless. I saw him perform it at that age, some four or five times, and never again in his life. The conditions were not present to fix a habit which should last when the prompting instinct died away. But suppose meat instead of a glove, earth instead of a carpet, hunger-pangs instead of a fresh supper a few hours later, and it is easy to see how this dog might have got into a habit of burying superfluous food, which might have lasted all his life. Who can swear that the strictly instinctive part of the food-burying propensity in the wild *Canidæ* may not be as short-lived as it was in this terrier?—JAMES *Psychology*, vol. ii, ch. 24, p. 399. (H. H. & Co., 1899.)

1703. INSTINCT, MATERNAL, OF THE SPIDER—The courage and rapacity of spiders as a class are too well and generally known to require special illustration. One instance, however, may be quoted to show the strength of their maternal emotions. Bonnet threw a spider with her bag of eggs into the pit of an ant-lion. The latter seized the eggs and tore them away from the spider; but altho Bonnet forced her out of the pit she returned, and chose to be dragged in and buried alive rather than leave her charge.—ROMANES *Animal Intelligence*, ch. 6, p. 205. (A., 1899.)

1704. INSTINCTS COMPLEX — *Diving Spider—Carrying Air to Its Watery Home.*—[The] strangest of all [spiders is] the *Argyroneta* that has its luminous dwelling at the bottom of streams; and just as a mason carries bricks and mortar to its building, so does this spider carry down bubbles of air from the surface to enlarge its mysterious house in which it lays its eggs and rears its young. Community of descent must be supposed of species having such curious and complex instincts; but how came these feeble creatures, unable to transport themselves over seas and continents like the aerial gossamer, to be so widely distributed and inhabiting regions with such different conditions? This can only be attributed to the enormous antiquity of the species.—HUDSON *Naturalist in La Plata*, ch. 14, p. 195. (C. & H., 1895.)

1705. INSTINCTS INNATE — *Young Animals Follow Ancestral Habits without Instruction.*—Among the lower animals, young ones taken from the litter or the nest and brought up under conditions wholly removed from the teaching of their parents, whether by imitation or otherwise, will reproduce exactly all those habits of their race which belong to their natural modes of life. Many of these habits—perhaps it may be safely said all of them—imply ideas—that is to say, they imply instincts; and instincts are in the nature of ideas—that is to say, they belong to the phenomena of mind. And of this there is another indication in a fact which at first sight may seem trivial or irrelevant. It has been often said that one great difficulty in reasoning on this subject is the inaccessibility to observation of the mental condition of all infant creatures. But even if this were more true than it really is there are some creatures, not low in the scale of creation, of which it may be said that, comparatively, they have no infancy at all. These are the gallinaceous birds in general, and some species in particular. They come forth from the egg perfect miniatures of their parents, and with minds as fully equipped with parental instincts as their bodies are provided with feathers or their wings with quills. Antecedent to all experience of injury they exhibit fear, and not only fear, but fear of the proper objects. They will flee when they see a hawk, and they will carefully avoid a stinging insect. In Europe the young of the wood-grouse or gelinotte are able to fly from the moment they break the shell.—ARGYLL *Reign of Law*, ch. 6, p. 176. (Burt.)

1706. INSTINCTS, NATURAL, FOLLOWED IN DOMESTICATION—An animal in domesticity, says M. F. Cuvier, is not essentially in a different situation, in regard to the feeling of restraint, from one left to itself. It lives in society without constraint, because, without doubt, it was a social animal; and it conforms itself to the will of man because it had a chief to which, in a wild state, it would have yielded obedience. There is nothing in its new situation that is not conformable to its propensities; it is satisfying its wants by submission to a master, and makes no sacrifice of its natural inclinations. All the social animals when left to themselves form herds more or less numerous; and all the individuals of the same herd know each other, are mutually attached, and will not allow a strange individual to join them. In a wild state, moreover, they obey some individual, which by its superiority has become the chief of the herd. Our domestic species had originally this sociability of disposition, and no solitary species, however easy it may be to tame it, has yet afforded true domestic races. We me. ly, therefore, develop to our own

advantage propensities which propel the individuals of certain species to draw near to their fellows.—LYELL *Principles of Geology,* bk. iii, ch. 35, p. 596. (A., 1854.)

1707. INSTINCTS OF LABOR BLIND AND RECKLESS—*Deadly Trades Never Lack Recruits.*—There are certain results for the attainment of which the natural instincts of individual men not only may be trusted, but must be trusted as the best and indeed the only guide. There are other results of which as a rule those instincts will take no heed whatever, and for the attainment of which, if they are to be attained at all, the higher faculties of our nature must impose their will in authoritative expressions of human law. In all that wide circle of operations which have for their immediate result the getting of wealth there is a sagacity and a cunning in the instincts of labor and in the love of gain compared with which all legislative wisdom is ignorance and folly. But the instincts of labor, having for their conscious purpose the acquisition of wealth, are instincts which, under the stimulus and necessities of modern society, are blind to all other results whatever. They override even the love of life; they silence even the fear of death. Trades in which the laborers never reach beyond middle life—trades in which the work is uniformly fatal within a few years—trades in which those who follow them are liable to loathsome and torturing disease—all are filled by the enlistment of an unfailing series of recruits. If, therefore, there be some things desirable or needful for a community other than the acquisition of wealth—if mental ignorance and physical degeneracy be evils dangerous to social and political prosperity, then these results cannot and must not be trusted to the instincts of individual men. And why? Because the few motives which bear upon them, and which consequently determine their conduct, have become almost as imperious as the motives which determine the conduct of the lower animals.—ARGYLL *Reign of Law,* ch. 7, p. 213. (Burt.)

1708. INSTINCTS VS. IMPULSES—*Memory and Reason Regulate Human Impulses—Blindness of Mere Instincts.*—Nothing is commoner than the remark that man differs from lower creatures by the almost total absence of instincts, and the assumption of their work in him by "reason." . . . Man has a far greater variety of impulses than any lower animal; and any one of these impulses taken in itself is as "blind" as the lowest instinct can be; but owing to man's memory, power of reflection, and power of inference, they come each one to be felt by him after he has once yielded to them and experienced their results in connection with a foresight of those results. In this condition an impulse acted out may be said to be acted out, in part at least, for the sake of its results.—JAMES *Psychology,* vol. ii, ch. 24, p. 389. (H. H. & Co., 1899.)

1709. INSTRUCTION MIGHT SAVE LIFE—*Need of Object-lessons—The Miner's Safety-lamp.*—Sir Humphry Davy, after having assured himself of the action of wire gauze [in cutting off a gas-flame], applied it to the construction of a lamp which should enable the miner to carry his light into an explosive atmosphere. He surrounded a common oil-lamp by a cylinder of wire gauze. So long as this lamp is fed by pure air the flame burns with the ordinary brightness of an oil flame; but when the miner comes into an atmosphere containing "fire-damp" his flame enlarges and becomes less luminous. This enlargement of the flame ought to be taken as a warning to retire. Still, tho a continuous explosive atmosphere extends from the air outside through the meshes of the gauze to the flame within, ignition is not propagated across the gauze. A defect in the gauze, the destruction of the wire at any point by oxidation, would cause explosion. The rapid motion of the lamp through the air, or the impact of a "blower" upon the lamp, might also force the flame through the meshes. In short, a certain amount of intelligence and caution is necessary in using the lamp. This intelligence, unhappily, is not always possessed, nor is this caution always exercised, and the consequence is that even with the safety-lamp explosions still occur. Before permitting a man or boy to enter a mine would it not be well to place these results, by experiment, visibly before him? Mere advice will not enforce caution; but let the miner have the physical image of what he is to expect clearly and vividly before his mind and he will find it a restraining force and a monitory influence long after the effect of cautioning words has passed away.—TYNDALL *Heat a Mode of Motion,* lect. 9, p. 262. (A., 1900.)

1710. INTELLECT, BOUNDARY-LINE OF—*Ordinary Lessons of Science Fail.*—The reverse process of the production of motion by consciousness is equally unpresentable to the mind. We are here, in fact, on the boundary-line of the intellect, where the ordinary canons of science fail to extricate us. If we are true to these canons we must deny to subjective phenomena all influence on physical processes. The mechanical philosopher, as such, will never place a state of consciousness and a group of molecules in the relation of mover and moved. Observation proves them to interact; but in passing from the one to the other we meet a blank which the logic of deduction is unable to fill.—TYNDALL *Fragments of Science,* vol. ii, ch. 15, p. 408. (A., 1900.)

1711. INTELLECT DEVELOPED BY STRUGGLE FOR LIFE AMONG MEN—*A Struggle of Brains.*—The result of the struggle for life is that in the long run that which is better because more perfect conquers that which is weaker and imperfect. In human life, however, this struggle for

life will ever become more and more of an intellectual struggle, not a struggle with weapons of murder. The organ which above all others in man becomes more perfect by the ennobling influence of natural selection is the brain. The man with the most perfect understanding, not the man with the best revolver, will in the long run be victorious; he will transmit to his descendants the qualities of the brain which assisted him in the victory. Thus then we may justly hope, in spite of all the efforts of retrograde forces, that the progress of mankind towards freedom, and thus to the utmost perfection, will, by the happy influence of natural selection, become more and more a certainty.—HAECKEL *History of Creation*, vol. i, ch. 7, p. 179. (K. P. & Co., 1899.)

1712. INTELLECT HAS OUTSTRIPPED HEART—There can be little doubt that in respect of justice and kindness the advance of civilized man has been less marked than in respect of quick-wittedness.—FISKE *Destiny of Man*, ch. 10, p. 74. (H. M. & Co., 1900.)

1713. INTELLECT, LIMITATIONS OF—*Mathematical Faculty Defective among Savages.*—We have ample evidence that in all the lower races of man what may be termed the mathematical faculty is either absent or, if present, quite unexercised. The bushmen and the Brazilian wood-Indians are said not to count beyond two. Many Australian tribes only have words for one and two, which are combined to make three, four, five, or six, beyond which they do not count. The Damaras of South Africa only count to three; and Mr. Galton gives a curious description of how one of them was hopelessly puzzled when he had sold two sheep for two sticks of tobacco each and received four sticks in payment. He could only find out that he was correctly paid by taking two sticks and then giving one sheep, then receiving two sticks more and giving the other sheep.—WALLACE *Darwinism*, ch. 15, p. 312. (Hum., 1889.)

1714. INTELLECT OF MAN CONQUERS THE EARTH—*Superiority to Local and Climatic Changes.*—Man differs essentially from all other mammals in this respect: that whereas any important adaptation to new conditions can be effected in them only by a change in bodily structure, man is able to adapt himself to much greater changes of conditions by a mental development leading him to the use of fire, of tools, of clothing, of improved dwellings, of nets and snares, and of agriculture. By the help of these, without any change whatever in his bodily structure, he has been able to spread over and occupy the whole earth; to dwell securely in forest, plain, or mountain; to inhabit alike the burning desert or the arctic wastes; to cope with every kind of wild beast, and to provide himself with food in districts where, as an animal trusting to Nature's unaided productions, he would have starved.—WALLACE *Darwinism*, ch. 15, p. 307. (Hum., 1889.)

1715. INTELLECT REQUIRED TO MAKE A UNIVERSE WHICH INTELLECT IS REQUIRED TO COMPREHEND—There is a singular lack of logic, as it seems to me, in the views of the materialistic naturalists. While they consider classification, or, in other words, their expression of the relations between animals or between physical facts of any kind, as the work of their intelligence, they believe the relations themselves to be the work of physical causes. The more direct inference surely is, that if it requires an intelligent mind to recognize them it must have required an intelligent mind to establish them. These relations existed before man was created; they have existed ever since the beginning of time; hence what we call the classification of facts is not the work of his mind in any direct original sense, but the recognition of an intelligent action prior to his own existence.—AGASSIZ *Geological Sketches*, ser. i, ch. 1, p. 22. (H. M. & Co., 1896.)

1716. INTELLIGENCE AND BARBARISM COEXISTING—*The Old Man of Cromagnon—Cave-dwellers Like American Indians.*—Professor Broca, who seems by no means disinclined to favor a simian origin for men, has the following general conclusions, which refer to the Cromagnon skulls: "The great volume of the brain, the development of the frontal region, the fine elliptical profile of the anterior portion of the skull, and the orthognathous form of the upper facial region are incontestably evidences of superiority which are met with usually only in the civilized races. On the other hand, the great breadth of face, the alveolar prognathism, the enormous development of the ascending ramus of the lower jaw, the extent and roughness of the muscular insertions, especially of the masticatory muscles, give rise to the idea of a violent and brutal race." He adds that this apparent antithesis, seen also in the limbs as well as in the skull, accords with the evidence furnished by the associated weapons and implements of a rude hunter-life, and at the same time of no mean degree of taste and skill in carving and other arts. He might have added that this is precisely the antithesis seen in the American tribes, among whom art and taste of various kinds, and much that is high and spiritual even in thought, coexisted with barbarous modes of life and intense ferocity and cruelty. The god and the devil were combined in these races, but there was nothing of the mere brute.—DAWSON *Facts and Fancies in Modern Science*, lect. 4, p. 162. (A. B. P. S.)

1717. INTELLIGENCE AND ENTERPRISE OF PRIMITIVE MAN—Paleolithic implements abound in the drift gravels; the surface is strewn with flint flakes and frag-

ments of flint implements; and at the present time it [Brandon] is the only place in England where gun-flints are still made. For this purpose one particular layer of flint is found to be peculiarly well adapted, on account of its hardness and fineness of grain, while another layer, less suitable for gun-flints, is known as "wall-stone," being much used for building purposes. Now it is interesting to find that even in very early times the merits of the gun-flint layer were well known and appreciated; for altho there is abundance of flint on the surface the ancient flint-men sank their shafts down past the layer of "wall-stone," which occurs at a depth of 19½ feet, to the gun-flint layer, which at the spot in question is 39 feet deep.—AVEBURY *Prehistoric Times*, ch. 4, p. 78. (A., 1900.)

1718. INTELLIGENCE IN LOWER FORMS OF LIFE—*Worms Show Method in Plugging Up Their Burrows—Difficulty of Drawing Dividing Line between the Intelligent and the Automatic.*—If we consider the cases [specified] we can hardly escape from the conclusion that worms show some degree of intelligence in their manner of plugging up their burrows. Each particular object is seized in too uniform a manner, and from causes which we can generally understand, for the result to be attributed to mere chance. That every object has not been drawn in by its pointed end may be accounted for by labor having been saved through some being inserted by their broader or thicker ends. No doubt worms are led by instinct to plug up their burrows; and it might have been expected that they would have been led by instinct how best to act in each particular case, independently of intelligence. We see how difficult it is to judge whether intelligence comes into play, for even plants might sometimes be thought to be thus directed; for instance, when displaced leaves redirect their upper surfaces towards the light by extremely complicated movements and by the shortest course. With animals actions appearing due to intelligence may be performed through inherited habit without any intelligence, altho aboriginally thus acquired. Or the habit may have been acquired through the preservation and inheritance of beneficial variations of some other habit; and in this case the new habit will have been acquired independently of intelligence throughout the whole course of its development. There is no a priori improbability in worms having acquired special instincts through either of these two latter means. Nevertheless, it is incredible that instincts should have been developed in reference to objects, such as the leaves or petioles of foreign plants, wholly unknown to the progenitors of the worms which act in the described manner. Nor are their actions so unvarying or inevitable as are most true instincts.—DARWIN *The Formation of Vegetable Mould*, ch. 2, p. 26. (Hum., 1887.)

1719. INTELLIGENCE OF ANIMALS—*Known to Man Only by Inference.*—By mind we may mean two very different things, according as we contemplate it in our own individual selves or in other organisms. For if we contemplate our own mind we have an immediate cognizance of a certain flow of thoughts or feelings, which are the most ultimate things, and indeed the only things of which we are cognizant. But if we contemplate mind in other persons or organisms we have no such immediate cognizance of thoughts or feelings. In such cases we can only infer the existence and the nature of thoughts and feelings from the activities of the organisms which appear to exhibit them. . . . All our knowledge of their operations is derived, as it were, through the medium of ambassadors, these ambassadors being the activities of the organism. Hence it is evident that in our study of animal intelligence we are wholly restricted to the objective method. Starting from what I know subjectively of the operations of my own individual mind and the activities which in my own organism they prompt, I proceed by analogy to infer from the observable activities of other organisms what are the mental operations that underlie them.—ROMANES *Animal Intelligence*, int., p. 1. (A., 1899.)

1720. ——— ——— *Limitations of—Ceaseless Surprise of the Casarita—Vain Toil without Understanding.*—Another and smaller species of *Furnarius (F. cunicularius)* resembles the oven-bird in the general reddish tint of its plumage, in a peculiar shrill reiterated cry, and in an odd manner of running by starts. From its affinity, the Spaniards call it "casarita" (or little house-builder). . . . The casarita builds its nest at the bottom of a narrow cylindrical hole, which is said to extend horizontally to nearly six feet underground. Several of the country people told me that when boys they had attempted to dig out the nest, but had scarcely ever succeeded in getting to the end of the passage. The bird chooses any low bank of firm sandy soil by the side of a road or stream. Here (at Bahia Blanca) the walls round the houses are built of hardened mud; and I noticed that one, which enclosed a courtyard where I lodged, was bored through by round holes in a score of places. On asking the owner the cause of this he bitterly complained of the little casarita, several of which I afterwards observed at work. It is rather curious to find how incapable these birds must be of acquiring any notion of thickness, for altho they were constantly flitting over the low wall they continued vainly to bore through it, thinking it an excellent bank for their nests. I do not doubt that each bird, as often as it came to daylight on the opposite side, was greatly surprised at the marvelous fact.—DARWIN *Naturalist's Voyage around the World*, ch. 5, p. 95. (A., 1898.)

1721. ——— ——— *Modification of Instinct in Birds—Jackdaws Build Buttress for Their Nest.*—A pair of jackdaws endeavored to construct their nest in one of the small windows that lighted the spiral staircase of an old church-tower. As is usual, however, in such windows, the sill sloped inwards with a considerable inclination; and, consequently, there being no level base for the nest, as soon as a few sticks had been laid, and it was beginning to acquire weight, it slid down. This seems to have happened two or three times; nevertheless the birds clung with great pertinacity to the site they had selected, and at last devised a most ingenious method of overcoming the difficulty. Collecting a great number of sticks, they built up a sort of cone upon the staircase, the summit of which rose to the level of the window-sill and afforded the requisite support to the nest; this cone was not less than six feet high, and so large at its base as quite to obstruct the passage up the staircase; yet, notwithstanding the large amount of material which it contained, it was known to have been constructed within four or five days. Now as this was a device quite foreign to the natural habit of the bird, and only hit upon after the repeated failure of its ordinary method of nest-building, the curious adaptation of means to ends which it displayed can scarcely be regarded in any other light than as proceeding from a design in the minds of the individuals who executed it.—CARPENTER *Mental Physiology,* ch. 2, p. 86. (A., 1900.)

1722. ——— ——— *The Ants Rank Near to Man—Superior to the Anthropoid Apes.*—The anthropoid apes no doubt approach nearer to man in bodily structure than do any other animals; but when we consider the habits of ants, their social organization, their large communities and elaborate habitations; their roadways, their possession of domestic animals, and even, in some cases, of slaves, it must be admitted that they have a fair claim to rank next to man in the scale of intelligence.—AVEBURY *Ants, Bees, and Wasps,* ch. 1, p. 1. (A., 1900.)

1723. ——— ——— *The Cat—Skill in Dealing with Mechanical Contrivances.*—I have received some half-dozen instances of this display of intelligence [the opening of a thumb-latch] on the part of cats. These instances are all such precise repetitions of one another that I conclude the fact to be one of tolerably ordinary occurrence among cats, while it is certainly very rare among dogs. I may add that my own coachman once had a cat which, certainly without tuition, learned thus to open a door that led into the stables from a yard into which looked some of the windows of the house. Standing at these windows when the cat did not see me, I have many times witnessed her *modus operandi.* Walking up to the door with a most matter-of-course kind of air, she used to spring at the half-hoop handle just below the thumb-latch. Holding on to the bottom of this half-loop with one forepaw, she then raised the other to the thumbpiece, and, while depressing the latter, finally with her hind legs scratched and pushed the doorposts so as to open the door. Precisely similar movements are described by my correspondents as having been witnessed by them.—ROMANES *Animal Intelligence,* ch. 14, p. 420. (A., 1899.)

1724. ——— ——— *The Elephant—Rapid Domestication—Limited Attainment—Education Early Becomes Complete.*—No animal affords a more striking illustration of the principal points which I have been endeavoring to establish than the elephant; for, in the first place, the wonderful sagacity with which he accommodates himself to the society of man, and the new habits which he contracts, are not the result of time, nor of modifications produced in the course of many generations. [Tho] these animals will breed in captivity, . . . it has always been the custom, as the least expensive mode of obtaining them, to capture wild individuals in the forests, usually when full grown; and in a few years after they are taken—sometimes, it is said, in the space of a few months—their education is completed.

Had the whole species been domesticated from an early period in the history of man, like the camel, their superior intelligence would, doubtless, have been attributed to their long and familiar intercourse with the lord of the creation, but we know that a few years is sufficient to bring about this wonderful change of habits, and altho the same individual may continue to receive tuition for a century afterwards, yet it makes no farther progress in the development of its faculties.—LYELL *Principles of Geology,* bk. iii, ch. 35, p. 598. (A., 1854.)

1725. ——— ——— *The Shepherd Dog—Story of the "Ettrick Shepherd"—Recovery of Lost Sheep.*—The following is a very remarkable case of this kind, which occurred in the experience of James Hogg, the "Ettrick Shepherd," the associate of Walter Scott and Christopher North:

Mr. Hogg goes on to narrate the following, among other remarkable exploits, in illustration of Sirrah's sagacity. About seven hundred lambs, which were at once under his care at weaning-time, broke up at midnight, and scampered off in three divisions across the hills, in spite of all that the shepherd and an assistant lad could do to keep them together. "Sirrah," cried the shepherd in great affliction, "my man, they're a' awa." The night was so dark that he did not see Sirrah; but the faithful animal had heard his master's words—words such as of all others were sure to set him most on the alert; and without any delay, he silently set off in quest of the recreant flock. Meanwhile the shepherd and his companion did not fail to do all that was in

their power to recover their lost charge; they spent the whole night in scouring the hills for miles around, but of neither the lambs nor Sirrah could they obtain the slightest trace. "It was the most extraordinary circumstance," says the shepherd, "that had ever occurred in the annals of the pastoral life. We had nothing for it (day having dawned) but to return to our master, and inform him that we had lost his whole flock of lambs, and knew not what was become of one of them. On our way home, however, we discovered a body of lambs at the bottom of a deep ravine, called the Flesh Clench, and the indefatigable Sirrah standing in front of them, looking all around for some relief, but still standing true to his charge. The sun was then up; and when we first came in view of them, we concluded that it was one of the divisions of the lambs, which Sirrah had been unable to manage until he came to that commanding situation. But what was our astonishment, when we discovered by degrees that not one lamb of the whole flock was wanting! How he had got all the divisions collected in the dark is beyond my comprehension. The charge was left entirely to himself, from midnight until the rising of the sun; and if all the shepherds in the forest had been there to have assisted him, they could not have effected it with greater propriety. All that I can further say is that I never felt so grateful to any creature below the sun as I did to my honest Sirrah that morning."—CARPENTER *Mental Physiology*, ch. 2, p. 102. (A., 1900.)

1726. ——— ——— *The Wasp—Taking Bearings—Starting Fresh When at Fault.*—A specimen of *Polistes carnifex* [or sand-wasp] was hunting about for caterpillars in my garden. I found one about an inch long, and held it out towards it on the point of a stick. It seized it immediately, and commenced biting it from head to tail, soon reducing the soft body to a mass of pulp. It rolled up about one-half of it into a ball, and prepared to carry it off. Being at the time amidst a thick mass of a fine-leaved climbing plant, it proceeded, before flying away, to take note of the place where it was leaving the other half. To do this, it hovered in front of it for a few seconds, then took small circles in front of it, then larger ones round the whole plant. I thought it had gone, but it returned again, and had another look at the opening in the dense foliage down which the other half of the caterpillar lay. It then flew away, but must have left its burden for distribution with its comrades at the nest, for it returned in less than two minutes, and, making one circle around the bush, descended to the opening, alighted on a leaf, and ran inside. The green remnant of the caterpillar was lying on another leaf inside, but not connected with the one on which the wasp alighted, so that in running in it missed it, and soon got hopelessly lost in the thick foliage. Coming out again, it took another circle, and pounced down on the same spot again, as soon as it came opposite to it. Three small seed-pods, which here grew close together, formed the marks that I had myself taken to note the place, and these the wasp seemed also to have taken as its guide, for it flew directly down to them, and ran inside; but the small leaf on which the fragment of caterpillar lay not being directly connected with any on the outside, it again missed it, and again got far away from the object of its search. It then flew out again, and the same process was repeated again and again. Always when in circling round it came in sight of the seed-pods, down it pounced, alighted near them, and recommenced its quest on foot. I was surprised at its perseverance, and thought it would have given up the search; but not so, it returned at least half a dozen times, and seemed to get angry, hurrying about with buzzing wings. At last it stumbled across its prey, seized it eagerly, and, as there was nothing more to come back for, flew straight off to its nest, without taking any further note of the locality. Such an action is not the result of blind instinct, but of a thinking mind; and it is wonderful to see an insect so differently constructed using a mental process similar to that of man.—ROMANES *Animal Intelligence*, ch. 4, p. 150. (A., 1899.)

1727. INTELLIGENCE OF HIGH ORDER—*Only Developed After Birth.*—When a creature's intelligence is high and its experience varied and complicated, the registration of all this experience in the nerve-centers of its offspring does not get accomplished before birth. There is not time enough. The most important registrations, such as those needed for breathing and swallowing and other indispensable acts, are fully effected; others, such as those needed for handling and walking, are but partially effected; others, such as those involved in the recognition of creatures not important as enemies or prey, are left still further from completion. Much is left to be done by individual experience after birth. The animal, when first born, is a baby dependent upon its mother's care. At the same time its intelligence is far more plastic, and it remains far more teachable, than the lower animal that has no babyhood.—FISKE *Through Nature to God*, pt. ii, ch. 7, p. 92. (H. M. & Co., 1900.)

1728. INTELLIGENCE REQUISITE FOR COOK—*Economy of Fuel.*—"I well know, from my own experience, how difficult it is to persuade cooks of this truth [of the utility of boiling-hot water], but it is so important that no pains should be spared in endeavoring to remove their prejudices and enlighten their understandings. This may be done most effectually in the case before us by a method I have several times put in practise with complete success. It is as follows: Take two equal boilers, containing

equal quantities of boiling hot water, and put into them two equal pieces of meat taken from the same carcass—two legs of mutton, for instance—and boil them during the same time. Under one of the boilers make a small fire, just barely sufficient to keep the water boiling hot, or rather just beginning to boil; under the other make as vehement a fire as possible, and keep the water boiling the whole time with the utmost violence. The meat in the boiler in which the water has been kept only just boiling hot will be found to be quite as well done as that in the other. It will even be found to be much better cooked, that is to say, tenderer, more juicy, and much higher flavored."—RUMFORD quoted by WILLIAMS in *Chemistry of Cookery*, ch. 2, p. 17. (A., 1900.)

1729. INTELLIGENCE SHOWN IN RELICS OF STONE AGE—*Language the True Mold of Mind.*—The flints and arrowheads, the celts and hammers, of early man are fossil intelligence; the remains of primitive arts and industries are petrified mind. But there is one mold into which mind has run more large and beautiful than any of these. When its contents are examined they carry us back not only to what men worked at with their hands, but to what they said to one another as they worked and what they thought as they spoke. That mold is language.—DRUMMOND *Ascent of Man*, p. 147. (J. P., 1900.)

1730. INTELLIGENCE THE FINAL VICTOR—*The Evolution of Mind.*—Nature is full of new departures; but never since time began was there anything approaching in importance that period when the slumbering animal brain broke into intelligence, and the creature first felt that it had a mind. From that dateless moment a higher and swifter progress of the world began. Henceforth, intelligence triumphed over structural adaptation. The wise were naturally selected before the strong. The mind discovered better methods, safer measures, shorter cuts. So the body learned to refer to it, then to defer to it. As the mind was given more to do, it enlarged and did its work more perfectly. Gradually the favors of evolution—exercise, alteration, differentiation, addition—which were formerly distributed promiscuously among the bodily organs—were now lavished mainly upon the brain. The gains accumulated with accelerating velocity; and by sheer superiority and fitness for its work the intellect rose to commanding power and entered into final possession of a monopoly which can never be disturbed.—DRUMMOND *Ascent of Man*, ch. 3, p. 116. (J. P., 1900.)

1731. INTEMPERANCE, DEBASING EFFECT OF—*Special Degradation of Woman—Moral Influence Defeated by Morbid Physical Craving.*—The debasing effect of continued alcoholic excess is, unfortunately, but too apparent. Cases like that of Hartley Coleridge, in which it seems only to excite the higher part of the intellectual and moral nature to an irregular activity, are extremely rare. Far more generally, while weakening the will and exciting the lower propensities, it blunts the moral sense also; and the wretched victim becomes so completely the slave of his tyrannical appetite for drink that he is ready to gratify it at any sacrifice. This moral degradation is perhaps even more marked in women than in men; for the drunkenness of the former (especially in the upper ranks of society) being usually secret—at least in the first instance—whilst in the latter it is generally open, it can only be practised by deceit and fraud; and when the habit has obtained such a dominance that the customary restraints are thrown aside, there is a more complete abandonment of self-respect. In either sex, it is the physical craving produced by the continued action of the stimulant upon the nutrition of the nervous system which renders the condition of the habitual drunkard one with which it is peculiarly difficult to deal by purely moral means. Vain is it to recall the motives for a better course of conduct, to one who is already familiar with them all, but is destitute of the will to act upon them; the seclusion of such persons from the reach of alcoholic liquors, for a sufficient length of time to free the blood from its contamination, to restore the healthful nutrition of the brain, and to enable the recovered mental vigor to be wisely directed, seems to afford the only prospect of reformation; and this cannot be expected to be permanent, unless the patient determinately adopts and steadily acts on the resolution to abstain entirely from that which, if again indulged in, will be poison alike to his body and to his mind, and will transmit its pernicious influence to his offspring.—CARPENTER *Mental Physiology*, ch. 17, p. 652. (A., 1900.)

1732. INTEMPERANCE, MORTALITY RESULTING FROM—*Effects of the Use of Alcohol in Switzerland.*—In the cities of Switzerland every ninth man dies, directly or indirectly, of the consequences of drunkenness. What objection can be made against these statistics? No one dares assert that they are the production of bias. Our physicians are not temperance fanatics. At most, one might object that the causal relations are not demonstrated in all cases, that many of the patients would have died even without alcohol, perhaps only a little later. I do not deny that. But what cannot be denied is the fact of drunkenness. The physicians cannot report drunkenness as the only, or the contributing, cause of death if the patient has not been given to drunkenness. It is therefore a fact that every ninth man in the cities of Switzerland becomes a drunkard.—VON BUNGE *Der Kampf gegen die Trinksitten* (an address). (Translated for *Scientific Side-Lights.)*

1733. INTERCHANGE OF LAND AND SEA—*Cities Where Ocean Once Rolled.*—Imperfect as is our information of the

changes which they [deltas] have undergone within the last three thousand years, they are sufficient to show how constant an interchange of sea and land is taking place on the face of our globe. In the Mediterranean alone, many flourishing inland towns, and a still greater number of ports, now stand where the sea rolled its waves since the era of the early civilization of Europe. If we could compare with equal accuracy the ancient and actual state of all the islands and continents, we should probably discover that millions of our race are now supported by lands situated where deep seas prevailed in earlier ages. In many districts not yet occupied by man, land animals and forests now abound where ships once sailed; and, on the other hand, we shall find, on inquiry, that inroads of the ocean have been no less considerable.—LYELL *Geology*, ch. 18, p. 289. (A., 1854.)

1734. ——— ——— *Coal-beds Buried under Ocean-rocks.*—All of the formations of the Secondary and Tertiary periods are on top of the coal—and this shows that after the age of rank vegetable growth there was a sinking of the earth in many places far down into the ocean—so that vast layers of rock formed on top of these beds of vegetable matter. In England great chalk-beds crop out in cliffs on the southern coast, and, as we have seen, these chalk-rocks are largely made up of the shells of marine animals. London stands on a chalk-bed from six hundred to eight hundred feet thick. Indeed, England has been poetically called Albion, White-land, from this appearance of her coast. All of the great chalk-beds were formed ages after the coal-beds, as the latter are found in the upper strata of the Paleozoic period.—ELISHA GRAY *Nature's Miracles*, vol. i, ch. 3, p. 26. (F. H. & H., 1900.)

1735. INTEREST, ACQUIRED, BECOMES CONTROLLING—An adult man's interests are almost every one of them intensely artificial: they have slowly been built up. The objects of professional interest are most of them, in their original nature, repulsive; but by their connection with such natively exciting objects as one's personal fortune, one's social responsibilities, and especially by the force of inveterate habit, they grow to be the only things for which in middle life a man profoundly cares. —JAMES *Talks to Teachers*, ch. 10, p. 98. (H. H. & Co., 1900.)

1736. INTEREST IN THE DIVINE RECORD—To me it seems that to look on the first land that was ever lifted above the waste of waters, to follow the shore where the earliest animals and plants were created when the thought of God first expressed itself in organic forms, to hold in one's hand a bit of stone from an old sea-beach, hardened into rock thousands of centuries ago, and studded with the beings that once crept upon its surface or were stranded there by some retreating wave, is even of deeper interest to men than the relics of their own race, for these things tell more directly of the thoughts and creative acts of God.—AGASSIZ *Geological Sketches*, ser. i, ch. 2, p. 29. (H. M. & Co., 1896.)

1737. INTEREST OF MAN IN ANIMALS — *Pigeons Carefully Bred by Ancient Egyptians—A Pastime of Nobles and Kings.* —The art of and fancy for pigeon-breeding is very ancient. Even more than 3,000 years before Christ it was carried on by the Egyptians. The Romans, under the emperors, laid out enormous sums upon the breeding of pigeons, and kept accurate pedigrees of their descent, just as the Arabs keep genealogical pedigrees of their horses, and the Mecklenburg aristocracy of their own ancestors. In Asia, too, among the wealthy princes, pigeon-breeding was a very ancient fancy; in 1600, the court of Akber Khan possessed more than 20,000 pigeons. Thus in the course of several centuries, and in consequence of the various methods of breeding practised in the different parts of the world, there has arisen out of one single originally tamed form an immense number of different races and varieties, which in their most divergent forms are extremely different from one another, and are often curiously characterized.—HAECKEL *History of Creation*, vol. i, ch. 6, p. 144. (K. P. & Co., 1899.)

1738. INTERPRETATION INSTINCTIVE—*The Less Known Explained by the Better Known—The Concave Seen in Relief.*—Now, it may be asked, why should we tend to transform the concave into the convex rather than the convex into the concave? . . . We are rendered much more familiar, both by Nature and by art, with raised *(cameo)* design than with depressed design *(intaglio)*, and we instinctively interpret the less familiar form by the more familiar. . . . [An] illustration of this kind of illusion recently occurred in my own experience. Nearly opposite to my window came a narrow space between two detached houses. This was, of course, darker than the front of the houses, and the receding parallel lines of the bricks appeared to cross this narrow vertical shaft obliquely. I could never look at this without seeing it as a convex column, round which the parallel lines wound obliquely. Others saw it as I did, tho not always with the same overpowering effect. I can only account for this illusion by help of the general tendency of the eye to solidify impressions drawn from the flat, together with the effect of special types of experience, more particularly the perception of cylindrical forms in trees, columns, etc.—SULLY *Illusions*, ch. 5, p. 85. (A., 1897.)

1739. INTERVENTION OF NATURAL CAUSES—*Not the Negation of Divine Power.*—The reluctance to admit, as belonging to the domain of Nature, any special

exertion of divine power for special purposes, stands really in very close relationship to the converse notion, that where the operation of natural causes can be clearly traced, there the exertion of divine power and will is rendered less certain and less convincing. This is the idea which lies at the root of Gibbon's famous chapters on the spread of Christianity. He labors to prove that it was due to natural causes. In proving this, he evidently thinks he is disposing of the notion that Christianity spread by divine power, whereas he only succeeds in pointing out some of the means which were employed to effect a divine purpose.—ARGYLL *Reign of Law*, ch. 1. p. 12. (Burt.)

1740. INTOLERANCE OF INFIDELITY—*Voltaire Denied Existence of Fossils—Mingled Ignorance and Inconsistency.*—Voltaire had used the modern discoveries in physics as one of the numerous weapons of attack and ridicule directed by him against the Scriptures. He found that the most popular systems of geology were accommodated to the sacred writings, and that much ingenuity had been employed to make every fact coincide exactly with the Mosaic account of the creation and deluge. It was, therefore, with no friendly feelings that he contemplated the cultivators of geology in general, regarding the science as one which had been successfully enlisted by theologians as an ally in their cause. He knew that the majority of those who were aware of the abundance of fossil shells in the interior of continents were still persuaded that they were proofs of the universal deluge; and as the readiest way of shaking this article of faith, he endeavored to inculcate skepticism as to the real nature of such shells, and to recall from contempt the exploded dogma of the sixteenth century, that they were sports of Nature. He also pretended that vegetable impressions were not those of real plants. Yet he was perfectly convinced that the shells had really belonged to living *Testacea*, as may be seen in his essay "On the Formation of Mountains." He would sometimes, in defiance of all consistency, shift his ground when addressing the vulgar, and, admitting the true nature of the shells collected in the Alps and other places, pretend that they were Eastern species, which had fallen from the hats of pilgrims coming from Syria. The numerous essays written by him on geological subjects were all calculated to strengthen prejudices, partly because he was ignorant of the real state of the science, and partly from his bad faith. On the other hand, they who knew that his attacks were directed by a desire to invalidate Scripture, and who were unacquainted with the true merits of the question, might well deem the old diluvian hypothesis incontrovertible, if Voltaire could adduce no better argument against it than to deny the true nature of organic remains.—LYELL *Principles of Geology*, bk i, ch. 4, p. 54. (A., 1854.)

1741. INTOLERANCE OF PAGANISM—*Science under Ban—Underestimate Denounced as Exaggeration—Persecution of Anaxagoras.*—The astronomers of the school of Pythagoras, who thought they gave a grand idea of the day star by estimating its distance at 72,000 kilometers (44,740 miles), and its diameter at 618 kilometers (384 miles), were as far from the reality as an ant who believed itself the size of a horse. And yet to estimate the sun as of the size of the Peloponnesus was then such boldness in the eyes of the classical conservatives and the teaching doctors that for having asserted this beginning of truth the philosopher Anaxagoras was outrageously persecuted and condemned to death—a sentence commuted to a decree of exile, on the petition of Pericles! The trial of Galileo was, later on, a repetition of that of Anaxagoras.—FLAMMARION *Popular Astronomy*, bk. iii, ch. 3, p. 244. (A.)

1742. INTOLERANCE OF THE SCHOOLMEN—*Discoveries in Anatomy and Physiology Met by Persecution.*—The more rigid the system, the fewer and the more thorough were the methods to which the healing art was restricted. The more the schools were driven into a corner by the increase in actual knowledge, the more did they depend upon the ancient authorities, and the more intolerant were they against innovation. The great reformer of anatomy, Vesalius, was cited before the theological faculty of Salamanca; Servetus was burned at Geneva along with his book, in which he described the circulation of the lungs; and the Paris faculty prohibited the teaching of Harvey's doctrine of the circulation of the blood in its lecture-rooms.—HELMHOLTZ *Popular Lectures*, lect. 5, p. 210. (L. G. & Co., 1898.)

1743. INTOLERANCE, PARALYZING EFFECT OF—*Abdication of Galileo—Science under Ban of Church.*—"Having held and believed that the sun is the center of the universe and immovable, and that the earth is not the center of the same and that it does move, . . . I abjure with a sincere heart and unfeigned faith, I curse and detest the said errors and heresies and generally all and every error and sect contrary to the Holy Catholic Church," wrote Galileo Galilei, in mortal terror of the Inquisition; that was in 1633. Twenty years before, under the protection of the Grand Duke of Tuscany, he had asserted the heliocentric doctrine, with no worse result than a friendly admonition from Cardinal Bellarmine, and he had agreed not to promulgate it further. But, as the world grew wiser, it smiled at the theological claims to infallibility in matters of physics, and at last, in 1620, the church itself yielded sufficiently to sanction the discussion of the Copernican theory as an hypothesis merely. This gave Galileo a safe opportunity, as he believed, once more publicly to reaffirm his belief therein. He went too far, and tried

to prove it orthodox. However the ecclesiastical authorities may have intended to deal with others, the fact of his having violated, as they claimed, his earlier promise gave them a reason for coming upon him despite the permissory decree. He was the most shining of all shining marks. To crush him would do more to paralyze independent philosophical thought, at least within the pale of the church, than any random anathema that Rome could hurl.

The effect upon all Europe was profound. The faithful, who found themselves in the van of philosophical progress, stopped and drew back. The blight of uncertainty fell upon them. If, after years of free discussion, Copernicanism had come to be heresy, inviting the dread visit of the Holy Office, what then might be safely taught and studied?—PARK BENJAMIN *Intellectual Rise of Electricity*, ch. 12, p. 355. (J. W., 1898.)

1744. ——— ——— *Buffon Recants His "Theory of the Earth."*—Soon after the publication of his "Natural History," in which was included his "Theory of the Earth," [Buffon] received an official letter (January, 1751) from the Sorbonne, or Faculty of Theology in Paris, informing him that fourteen propositions in his works "were reprehensible and contrary to the creed of the church." The first of these obnoxious passages, and the only one relating to geology, was as follows: "The waters of the sea have produced the mountains and valleys of the land—the waters of the heavens, reducing all to a level, will at last deliver the whole land over to the sea, and the sea successively prevailing over the land will leave dry new continents like those which we inhabit." Buffon was invited by the college, in very courteous terms, to send in an explanation, or rather a recantation of his unorthodox opinions. To this he submitted, and a general assembly of the faculty having approved of his "Declaration," he was required to publish it in his next work. The document begins with these words: "I declare that I had no intention to contradict the text of Scripture; that I believe most firmly all therein related about the creation, both as to order of time and matter of fact; and I abandon everything in my book respecting the foundation of the earth, and generally all which may be contrary to the narration of Moses."—LYELL *Principles of Geology*, bk. i, ch. 3, p. 39. (A., 1854.)

1745. INTOXICATION ONE WITH INSANITY—*Difference Only in Duration—Poison Gradually Eliminated from the Blood.*—The states of mind temporarily produced by intoxicating agents—alcohol, opium, hashish, and the like—are closely akin to one another in this fundamental character, as they are also to the delirium of fevers or other diseases, which is due to the introduction of a morbid matter into the blood, whereby a zymosis or fermentation of its own materials is produced which gives it a poisonous action on the brain. In the second case, as in the first, the effect is transient, the poison being gradually eliminated from the circulation by the excretory apparatus (including the respiratory organs), so that the blood regains its original purity. And it is this temporary character alone which differentiates the mental perversion of intoxication and delirium from that which is persistent in insanity.—CARPENTER *Mental Physiology*, bk. ii, ch. 17, p. 637. (A., 1900.)

1746. ——— ——— *Monomania—Sea Captain Shooting Sailors to Suppress Imaginary Mutiny—Small Portion of Stimulant Harmful—Heredity.*—The closeness of the affinity between the states of insanity and alcoholic intoxication is further made apparent by the extreme readiness with which the balance of reason is disturbed by a small quantity of liquor in those unfortunate individuals in whom there exists a predisposition to mental derangement. The power of volitional control being already feeble it is easily overthrown; and the propensities or passions which are always unduly excitable are readily aroused into morbid activity by this provocation, so that a very few glasses of wine or a small quantity of spirits are sufficient to induce what may be regarded either as a fit of drunkenness or a paroxysm of insanity—the two influences concurring to produce the mental disturbance which neither of them would have alone sufficed to bring about. Not unfrequently the state thus induced is one of temporary monomania, the mind becoming possessed by a particular emotional state which governs the conduct and leads to the perpetration of atrocious crimes. Thus at least two instances of this kind have occurred within the recollection of the writer in which the captain of a ship, having been thus seized with the belief that his crew was in a state of mutiny, has killed one of them after another in (as he believed) rightful self-defense. Such a predisposition may arise from previous injury or disease affecting the brain (tropical sunstroke being often alleged as the cause of it), or it may be inherited; and it exists in peculiar force in those who have an hereditary tendency to insanity derived from drunkenness on the part of the parents. Cases are continually occurring in which drunken outrages are committed by individuals thus circumstanced, in whose excuse it is alleged that a very small quantity of liquor is sufficient to inflame their passions and destroy their self-control. —CARPENTER *Mental Physiology*, ch. 17, p. 651. (A., 1900.)

1747. INTROSPECTION A MARVELOUS POWER—*Evidence of Mental Growth.*—There is nothing more wonderful in the constitution of our minds than the power we have of standing aside, as it were, for a time from the ordinary channel of our own thoughts and of looking back upon their cur-

rents coming down from the hills of memory and association to join their issues in our present life. But this sort of looking in upon ourselves and treating ourselves as a subject of natural history is to all men a difficult and to most men an impossible operation. They have neither time for it nor thought for it. The conscious energies of the will are so near us and so ever present with us that they shut out our view of the forces which lie behind. Yet there are some facts common in the experience of all men which may help us to a conception of the truth. One of these is the fact of mind growing with the growth of years—a fact determined by the recollection of childhood, of youth, and of maturity. By comparing ouselves with ourselves at former periods of life—by the memory of feelings and of opinions, and of methods of thought which we have outgrown and left behind us, we can detect the action of forces which have told upon our minds—traces, in short, of the laws to which they have been subject. Some of these laws have been nothing more than laws of physical growth—the conceptions of the mind undergoing a development consequent on the growth of our material organism.—ARGYLL *Reign of Law*, ch. 6, p. 171. (Burt.)

1748. INTUITIONS NOT EXPLAINED BY EXPERIENCE OF INDIVIDUAL OR OF RACE—*The Ancient Explanation (Job xxxii, 8).*—It is a familiar truth that some propositions are necessary. We must attach the predicate "equal" to the subject "opposite sides of a parallelogram" if we think those terms together at all, whereas we need not in any such way attach the predicate "rainy," for example, to the subject "tomorrow." The dubious sort of coupling of terms is universally admitted to be due to "experience"; the certain sort is ascribed to the "organic structure" of the mind. This structure is in turn supposed by the so-called apriorists to be of transcendental origin, or at any rate not to be explicable by experience; whilst by evolutionary empiricists it is supposed to be also due to experience, only not to the experience of the individual, but to that of his ancestors as far back as one may please to go. . . . Taking the word "experience" as it is universally understood, the experience of the race can no more account for our necessary or a priori judgments than the experience of the individual can.—JAMES *Psychology*, vol. ii, ch. 28, p. 617. (H. H. & Co., 1899.)

1749. INUNDATION POSSIBLE—*Subsidence of Land Might Empty Lake Superior.*—If we restrict ourselves to combinations of causes at present known it would seem that the two principal sources of extraordinary inundations are, first, the escape of the waters of a large lake raised far above the sea; and, secondly, the pouring down of a marine current into lands depressed below the mean level of the ocean.

As an example of the first of these cases we may take Lake Superior, which is more than 400 geographical miles in length and about 150 in breadth, having an average depth of from 500 to 900 feet. The surface of this vast body of fresh water is no less than 600 feet above the level of the ocean; the lowest part of the barrier which separates the lake on its southwest side from those streams which flow into the head waters of the Mississippi being about 600 feet high. If, therefore, a series of subsidences should lower any part of this barrier 600 feet, any subsequent rending or depression, even of a few yards at a time, would allow the sudden escape of vast floods of water into a hydrographical basin of enormous extent. If the event happened in the dry season, when the ordinary channels of the Mississippi and its tributaries are in a great degree empty, the inundation might not be considerable; but if in the flood season, a region capable of supporting a population of many millions might be suddenly submerged.—LYELL *Principles of Geology*, bk. i, ch. 10, p. 156. (A., 1854.)

1750. INVENTION AMONG SAVAGES—*Devices for Deluding Game—Origin of the "Stalking-horse."*—The Australian hunter takes the wallaby (a small kangaroo) by fastening to a long rod like a fishing-rod a hawk's skin and feathers, making the sham bird hover with its proper cry till it drives the game into a bush where it can be speared. Of devices of stalking with an imitated animal one of the most perfect is that of the Dogrib Indians, when a pair of hunters go after reindeer; the foremost carries a reindeer's head, while in the other hand he has a bunch of twigs against which he makes the head rub its horns in a lifelike way, and the two men, walking as the deer's fore and hind legs, get among the herd and bring down the finest. In England, till of late years, fowlers used to hide behind a wooden horse moved along on wheels, and a relic of this survives in the phrase "to make a stalking-horse of one," often now used by people who have no idea what the word meant.—TYLOR *Anthropology*, ch. 9, p. 209. (A., 1899.)

1751. ——— ——— *Possibilities of New Implement Exhausted — Mechanical Progress.*—I find that in the employment of the curved knife the Eskimo, the Canadian tribes, together with their kindred on the northern boundary of the United States, and, more than all, the North Pacific tribes on both sides of the ocean have exhausted the possibilities of an implement that has been in the hands of some only a century or two. The arts of all these tribes were bettered and not degraded by the curved knife. In every case they were immensely improved. The form of knife with straight, short blade made it possible for the northern and western tribes to become better carvers and engravers. Before the possession

of iron there is meager evidence that either of these areas possessed other than the most trivial carvings in hard material. Their best results were in soft wood and slate, by means of beaver-tooth or shark's-tooth knives. The curved knife serves to confirm the opinion that as soon as any process or device came within the scope of a people's intelligence they have mastered it and brought it to a climax, from which time on new ideas and new inventions replaced the old.—MASON *The Man's Knife among the North American Indians (Report of U. S. National Museum for 1897*, p. 742).

1752. INVENTION AND DISCOVERY—*The Discoverer Rarely an Inventor.*—By a discovery in science is understood the development of a knowledge of the existence of some principle in Nature not before known or but partially understood, while the term invention indicates the application of this knowledge, either simply or in combination with other knowledge, to some useful purpose in the arts. For example, Franklin discovered the principle of electrical induction, or the action at a distance of a charged body on a conductor, and on this founded his invention of the lightning-rod. It sometimes happens that the peculiar characteristics of mind and training necessary to the successful prosecution of these two branches of labor are found combined in the same individual. Of a happy combination of this kind James Watt affords a striking example, the like of which will become more common in proportion as the means of intellectual improvement afforded to workmen are extended. Generally, however, the two faculties exist in the greatest degree of development in separate individuals. The successful investigation of a new principle in science generally requires much previous study and preparation and a logical training, which few men, however vigorous may be their native intellect, can dispense with, and to acquire which the opportunities of the workmen are inadequate. On the other hand, the successful introduction to common use of an invention requires a contest with the world from which the sensitive student of abstract science shrinks with repugnance. I consider these remarks of some importance, because in this country, where there is so great a demand for immediate practical results, the value of labor in the line of abstract science is not properly appreciated or encouraged.—HENRY *Improvement of the Mechanical Arts (Scientific Writings*, vol. i, p. 319). (Sm. Inst., 1886.)

1753. INVENTION A NECESSITY FOR PRIMITIVE WOMAN—To feed the flock under her immediate care woman had to become an inventor, and it is in this activity of her mind that she is specially interesting here. The hen scratches for her chicks all day long, because Nature has fastened her hoes and rakes and cutting apparatus upon her body. But here stands a creature on the edge of time who had to create the implements of such industry. It is true that all the ages and all experiences and examples of the zoological world were around her. So had they been around other creatures. But the power to associate new ideas constantly and independently was to be for the first time her peculiar endowment as a bringer of food.—MASON *Woman's Share in Primitive Culture*, ch. 2, p. 14. (A., 1894.)

1754. INVENTION DRIVING TO INVENTION—*Scattered Workers Crowded Together—Time and Cost of Collection Fatal —The Factory System Becomes a Necessity.* —Towards the middle of the eighteenth century the greatest difficulty was experienced by weavers and spinners in England in maintaining their position in the markets of the world. It is curious how each new mechanical invention gave rise to the necessities out of which the next arose. The invention of the fly-shuttle in weaving, so early as 1733, seems to have given the first impulse to all that followed. By means of this invention the power of weaving overtook the power of spinning. An adequate supply of yarn could not be procured under the ancient methods of that most ancient industry. New conditions gave rise to new motives, and new motives called into play the latent energies of mind. The time and the cost of collecting the products of so many scattered laborers enhanced unduly the cost of manufacture, and even when the remuneration was reduced to the lowest point compatible with existence that cost was still too high. Something was imperatively required to economize the work of human hands—some more elaborate contrivance to make that work go further than before. And so Hargreaves's invention arose, not before the time. And when his spinning-jenny had been invented, a still more elaborate and powerful combination of mechanical adjustments was soon perfected in the hands of Arkwright. When the spinning-frame was invented, and when Crompton's farther invention of the mule-jenny speedily followed, the new order of things had been fairly inaugurated. The great change had come, and the survivance of the ancient domestic industries of so many centuries was no longer possible.—ARGYLL *Reign of Law*, ch. 7, p. 206. (Burt.)

1755. INVENTION GIVES INCREASING POWER—*Great Results from Small Beginning—Magnetic Induction.*—The story of the discovery of magnetic induction by Faraday and Henry is most instructive, for it shows how an apparently slight and unimportant manifestation of energy can be exalted by proper means into a tremendous one. Faraday remarked, after detailing his experiments on magnetic induction: "The various experiments of this section prove, I think, most completely the production of electricity from ordinary magnetism. That

its intensity should be very feeble and quantity small cannot be considered wonderful when it is remembered that, like thermo-electricity, it is evolved entirely within the substance of metals retaining all their conducting power." The steam-engine has exalted this apparently feeble effect discovered by Faraday into a power which is only limited by that of the steam-engine or the water-power which we employ.—TROWBRIDGE *What is Electricity?* ch. 1, p. 9. (A., 1899.)

1756. INVENTION INDIGENOUS IN MAN—Invention is indigenous in the nature of man. The first being on this earth worthy of that name was an inventor. The only moment in the life of an individual or a people in which the distinction of true humanity may be worthily bestowed on them is that in which something new is added to the stock of knowledge or experience. When men or nations originate, they live and grow; when they cease to do that, they decay and die. This has been true from the beginning.—MASON *Origins of Invention*, ch. 12, p. 410. (S., 1899.)

1757. INVENTION OF THE SAND-BLAST—*Man Taught by Processes of Nature.*—The sphinx of Egypt is nearly covered up by the sand of the desert. The neck of the sphinx is partly cut across, not, as I am assured by Mr. Huxley, by ordinary weathering, but by the eroding action of the fine sand blown against it. In these cases Nature furnishes us with hints which may be taken advantage of in art; and this action of sand has been recently turned to extraordinary account in the United States. When in Boston [1872] I was taken by my courteous and helpful friend, Mr. Josiah Quincey, to see the action of the sand-blast. A kind of hopper containing fine silicious sand was connected with a reservoir of compressed air, the pressure being variable at pleasure. The hopper ended in a long slit, from which the sand was blown. A plate of glass was placed beneath this slit and caused to pass slowly under it; it came out perfectly depolished, with a bright opalescent glimmer, such as could only be produced by the most careful grinding. Every little particle of sand urged against the glass, having all its energy concentrated on the point of impact, formed there a little pit, the depolished surface consisting of innumerable hollows of this description.—TYNDALL *Fragments of Science*, vol. i, ch. 7, p. 193. (A., 1897.)

1758. INVENTION UNSUCCESSFUL—*Destructibility of Lava—Artificial Stone Lacks Endurance.*—Some years ago a very ingenious invention was submitted to trial in the works of the Messrs. Chance, of Birmingham. It had been suggested that if certain lavas of easy fusibility were melted and poured into molds we might thus obtain elaborately ornamented stonework, composed of the hardest material, without the labor of the mason. The molten rock when quickly cooled was found to assume the form of a black glass, but when very slowly cooled passed into a stony material. Unfortunately, it was found that this material did not withstand the weather like ordinary building stones, and in consequence the manufacture had to be abandoned.—JUDD *Volcanoes*, ch. 3, p. 5. (A., 1899.)

1759. INVENTIONS OF PRIMITIVE MAN—*The Roller and the Pulley among American Aborigines.*—The roller I have found certainly in two areas. The Eskimos, in landing a heavily laden skin-boat, according to Elliott, lay down on the beach, in a row, inflated sealskins, used as floats with their harpoons. Upon these the craft is beached without the vexation of unloading her. A moment's reflection will show that in this apparatus the pneumatic tire is foreshadowed. The other example of the roller is the use made of it on the North Pacific coast in moving the great logs to be used in constructing the communal houses. The pulley in its simplest form is described as an invention of tepee-dwelling Indians of the plains. When the women had set up the three chief poles of the tent, the skin cover was hauled up by a line fastened to the top margin, passed over the fork of the poles above, and hauled by women at the other end. When the time came to strike tent, the line was loosed and the poles drawn together at their bases. Elliott, however, figures a group of Eskimos landing a huge walrus by means of a compound pulley. A long, stout walrus line passes around greasy pegs driven between the rocks and through slits cut in the animal's hide.—MASON *Aboriginal American Mechanics* (*Memoirs of the International Congress of Anthropology*, p. 76). (Sch. P. C.)

1760. INVESTIGATION, ORIGINAL—*The Mainspring of Technical Education.*—At the present time there is a cry in England for technical education, and it is a cry in which the most commonplace intellect can join, its necessity is so obvious. But there is no cry for original investigation. Still without this, as surely as the stream dwindles when the spring dies, so surely will "technical education" lose all force of growth, all power of reproduction. Our great investigators have given us sufficient work for a time; but if their spirit die out we shall find ourselves eventually in the condition of those Chinese mentioned by De Tocqueville, who, having forgotten the scientific origin of what they did, were at length compelled to copy without variation the inventions of an ancestry wiser than themselves who had drawn their inspiration direct from Nature.—TYNDALL *Lectures on Light*, p. 218. (A., 1898.)

1761. INVESTIGATION, UNTIRING SPIRIT OF, IN MONKEY—*Patient Industry Evinced.*—In conclusion, I should say that

much the most striking feature in the psychology of this animal [a brown capuchin monkey], and the one which is least like anything met with in other animals, was the tireless spirit of investigation. The hours and hours of patient industry which this poor monkey has spent in ascertaining all that his monkey intelligence could of the sundry unfamiliar objects that fell into his hands might well read a lesson in carefulness to many a hasty observer. And the keen satisfaction which he displayed when he had succeeded in making any little discovery, such as that of the mechanical principle of the screw, repeating the results of his newly earned knowledge over and over again, till one could not but marvel at the intent abstraction of the "dumb brute"—this was so different from anything to be met with in any other animal that I confess I should not have believed what I saw unless I had repeatedly seen it with my own eyes. As my sister once observed while we were watching him conducting some of his researches, in oblivion to his food and all his other surroundings, "When a monkey behaves like this it is no wonder that man is a scientific animal!"—ROMANES *Animal Intelligence*, ch. 17, p. 497. (A., 1899.)

1762. INVESTIGATION VS. DOGMA—*The Scientific Spirit.*—The history of science teaches us the difficulties that have opposed the progress of this active spirit of inquiry. Inaccurate and imperfect observations have led, by false inductions, to the great number of physical views that have been perpetuated as popular prejudices among all classes of society. Thus by the side of a solid and scientific knowledge of natural phenomena there has been preserved a system of the pretended results of observation, which is so much the more difficult to shake, as it denies the validity of the facts by which it may be refuted. This empiricism, the melancholy heritage transmitted to us from former times, invariably contends for the truth of its axioms with the arrogance of a narrow-minded spirit. Physical philosophy, on the other hand, when based upon science, doubts because it seeks to investigate, distinguishes between that which is certain and that which is merely probable, and strives incessantly to perfect theory by extending the circle of observation.—HUMBOLDT *Cosmos*, vol. i, int., p. 38. (H., 1897.)

1763. INVESTIGATORS OFTEN BAD LECTURERS—*Advanced Thinker Sees Things in Masses—Anecdote of Laplace.*—An advanced thinker sees the relations of his topics in such masses and so instantaneously that when he comes to explain to younger minds it is often hard to say which grows the more perplexed, he or the pupil. In every university there are admirable investigators who are notoriously bad lecturers. The reason is that they never spontaneously see the subject in the minute articulate way in which the student needs to have it offered to his slow reception. They grope for the links, but the links do not come. Bowditch, who translated and annotated Laplace's "Mécanique Céleste," said that whenever his author prefaced a proposition by the words "it is evident," he knew that many hours of hard study lay before him.—JAMES *Psychology*, vol. ii, ch. 22, p. 369. (H. H. & Co., 1899.)

1764. INVIGORATION OF NEGATIVE CHARACTER—*Overcoming, Not Removal of Difficulties—Self-reliance To Be Fostered.*—With a character of [the negative] type, the object of the judicious educator will be to invigorate the whole nature, corporeal as well as physical; to find out what worthy objects of pursuit have the most attraction for his pupil, and to aid and encourage his steady pursuit of them, not by removing difficulties from his path, but by helping him to surmount them, and in this manner to foster habits of self-reliance, which, when once formed, whether in regard to manly exercises or to the work of the intellect, may be looked to as available for the moral direction of the conduct.—CARPENTER *Mental Physiology*, bk. i, ch. 9, p. 428. (A., 1900.)

1765. INVISIBLE, THE, MADE VISIBLE—*Ultraviolet Waves Revealed by Fluorescence.*—As a general rule, bodies either transmit light or absorb it; but there is a third case in which the light falling upon the body is neither transmitted nor absorbed, but converted into light of another kind. Professor Stokes, the occupant of the chair of Newton in the University of Cambridge, has demonstrated this change of one kind of light into another, and has pushed his experiments so far as to render the invisible rays visible. A large number of substances examined by Stokes, when excited by the invisible ultraviolet waves, have been proved to emit light. You know the rate of vibration corresponding to the extreme violet of the spectrum; you are aware that to produce the impression of this color, the retina is struck 789 millions of millions of times in a second. At this point, the retina ceases to be useful as an organ of vision, for tho struck by waves of more rapid recurrence, they are incompetent to awaken the sensation of light. But when such nonvisual waves are caused to impinge upon the molecules of certain substances—on those of sulfate of quinin, for example—they compel those molecules, or their constituent atoms, to vibrate; and the peculiarity is, that the vibrations thus set up are of slower period than those of the exciting waves. By this lowering of the rate of vibration through the intermediation of the sulfate of quinin, the invisible rays are brought within the range of vision. . . . Casting by means of a prism a spectrum . . . upon a sheet of paper which has been wetted with a saturated solution of the sulfate of

quinin, and afterwards dried, an obvious extension of the spectrum is revealed. We have, in the first instance, a portion of the violet rendered whiter and more brilliant; but, besides this, we have the gleaming of the color where, in the case of unprepared paper, nothing is seen. Other substances produce a similar effect. A substance, for example, recently discovered by President Morton, and named by him thallene, produces a very striking elongation of the spectrum, the new light generated being of peculiar brilliancy. . . . [Stokes] called this rendering visible of the ultraviolet rays fluorescence.—TYNDALL *Lectures on Light*, lect. 4, p. 163. (A., 1898.)

1766. IRON AMONG THE HEBREWS —*Discovery of Dim Antiquity.*—It has been suggested that such iron as has been found in Egypt, and referred to Pharaonic times, may have been made and used by the Hebrews during their servitude, and that when they left the country they carried their knowledge with them. That they were familiar with the metal at the period of Moses, and hence at about 1500 years B. C., and possibly had known of it then for a long time, is shown by the mention of Tubal Cain, "an instructor of every artificer in brass and iron," as a personage of great antiquity, at the very beginning of the Pentateuch. Their continuing knowledge of it, over many centuries, is further shown by the Biblical references to the bed of iron of Og, the iron chariots of Javin, the miraculous floating ax-head of Elisha, the question "shall iron break the northern iron and the steel" in the Jeremiad, and many other instances, easily found.—PARK BENJAMIN *Intellectual Rise in Electricity*, ch. 1, p. 28. (J. W., 1898.)

1767. IRRELIGION MAY RESULT FROM DEGENERACY—It must be remembered that even if it had been true that some savages do exist with no conception whatever of living beings higher than themselves, it would be no proof whatever that such was the primeval condition of man. The . . . most degraded savagery of the present day is or may be the result of evolution working upon highly unfavorable conditions. . . . Degradation being a process which has certainly operated, and is now operating upon some races, and to some extent, it must always remain a question how far this process may go in paralyzing the activity of our higher powers, or in setting them, as it were, to sleep.—ARGYLL *Unity of Nature*, ch. 11, p. 281. (Burt.)

1768. IRRIGATION, SYSTEM OF, AMONG NORTH-AMERICAN INDIANS—No aborigines, unaided by domestic animals, have displayed so much patience and ingenuity in the storage and conducting of water as the Indians of the arid region of the United States. Throughout the public region, says Mr. Hodge, works of irrigation abound in the valleys and on the mountain slopes, especially along the drainage of the Gila and the Salado, in Southern Arizona, where the inhabitants are engaged in agriculture to a vast extent by this means. The arable tract of the Salado comprises 450,000 acres, and the ancient inhabitants controlled the watering of at least 250,000 acres. The outlines of one hundred and fifty miles of ancient main irrigating ditches may be readily traced, some of which meander southward a distance of fourteen miles. In one place the main canal was found to be a ditch within a ditch, the bed being seven feet deep. The lower section was only four feet wide, but the sides broadened in their ascent to a "bench" three feet wide on each side of the canal. Remains of balsas were recovered, showing that the transportation of material was also carried on. Remains of flood-gates were found by Mr. Cushing, and great reservoirs for storage of water, one example being 200 feet long and 15 feet in depth.—MASON *Aboriginal American Mechanics (Memoirs of the International Congress of Anthropology*, p. 82). (Sch. P. C.)

1769. IRRITATION OF SKIN BY ALPINE SUNSHINE—*Power of Chemical Rays.*—There would seem to be some specific quality in the sun's rays which produces the irritation of the skin experienced in the Alps. The solar heat may be compared, in point of *quantity*, with that radiated from a furnace; and the heat encountered by the mountaineer on Alpine snows is certainly less intense than that endured by workmen in many of our technical operations. But the terrestrial heat appears to lack the *quality* which gives the solar rays their power. The sun is incomparably richer in what are called chemical rays than are our fires, and to such rays the irritation may be due.—TYNDALL *Hours of Exercise in the Alps*, ch. 15, p. 169. (A., 1898.)

1770. ISLAND CREATED IN ONE GENERATION—There can be little doubt, from the account given by Captain Beechey, that Matilda Atoll in the Low Archipelago has been converted in the space of thirty-four years from being, as described by the crew of a wrecked whaling-vessel, a "reef of rocks," into a lagoon-island fourteen miles in length, with "one of its sides covered nearly the whole way with high trees." The islets, also, on Keeling Atoll, it has been shown, have increased in length, and since the construction of an old chart several of them have become united into one long islet.—DARWIN *Coral Reefs*, ch. 4, p. 101. (A., 1900.)

1771. ISLAND RISES AMONG AZORES—*Wide-spread Earthquakes—Distant Echo of Eruption.*—The sudden appearance, on the 30th of January, 1811, of the island of Sabrina, in the group of the Azores, was the precursor of the dreadful earthquakes which, further westward, shook, from May, 1811 to June, 1813, almost uninterruptedly,

first the Antilles, then the plains of the Ohio and Mississippi, and lastly the opposite coasts of Venezuela or Caracas. Thirty days after the total destruction of the beautiful capital of the province there was an eruption of the long inactive volcano of St. Vincent, in the neighboring islands of the Antilles. A remarkable phenomenon accompanied this eruption; at the moment of this explosion, which occurred on the 30th of April, 1811, a terrible subterranean noise was heard in South America, over a district of more than 35,000 square miles. The inhabitants of the banks of the Apure, at the confluence of the Rio Nula, and those living on the remote seacoast of Venezuela, agreed in comparing this sound to the noise of heavy artillery. The distance from the confluence of the Rio Nula with the Apure (by which I entered the Orinoco) to the volcano of St. Vincent, measured in a straight line, is no less than 628 miles. This noise was certainly not propagated through the air, and must have arisen from some deep-seated subterranean cause; its intensity was, moreover, hardly greater on the shores of the Caribbean Sea, near the seat of the raging volcano, than in the interior of the country in the basin of the Apure and the Orinoco.—HUMBOLDT *Views of Nature*, p. 361. (Bell, 1896.)

1772. ISLANDS OF CORAL—*Growing in Spite of Beating Surge—Advance against Resistance.*—Of thirty-two of these coral islands visited by Beechey in his voyage to the Pacific, twenty-nine had lagoons in their centers. The largest was 30 miles in diameter and the smallest less than a mile. All were increasing their dimensions by the active operations of the lithophytes, which appeared to be gradually extending and bringing the immersed parts of their structure to the surface. The scene presented by these annular reefs is equally striking for its singularity and beauty. A strip of land a few hundred yards wide is covered by lofty coconut-trees, above which is the blue vault of heaven. This band of verdure is bounded by a beach of glittering white sand, the outer margin of which is encircled with a ring of snow-white breakers, beyond which are the dark, heaving waters of the ocean. The inner beach encloses the still clear water of the lagoon, resting in its greater part on white sand, and, when illuminated by a vertical sun, of a most vivid green. Certain species of zoophytes abound most in the lagoon, others on the exterior margin where there is a great surf. "The ocean," says Mr. Darwin, "throwing its breakers on these outer shores, appears an invincible enemy, yet we see it resisted and even conquered by means which at first seem most weak and inefficient. No periods of repose are granted, and the long swell caused by the steady action of the trade-wind never ceases. The breakers exceed in violence those of our temperate regions, and it is impossible to behold them without feeling a conviction that rocks of granite or quartz would ultimately yield and be demolished by such irresistible forces. Yet these low, insignificant coral islets stand and are victorious, for here another power, as antagonist to the former, takes part in the contest. The organic forces separate the atoms of carbonate of lime one by one from the foaming breakers, and unite them into a symmetrical structure; myriads of architects are at work night and day, month after month, and we see their soft and gelatinous bodies through the agency of the vital laws conquering the great mechanical power of the waves of an ocean, which neither the art of man nor the inanimate works of Nature could successfully resist."—LYELL *Principles of Geology*, bk. iii, ch. 50, p. 780. (A., 1854.)

1773. ISLANDS OF FLOATING SEAWEED — *The Sargasso Fauna — Floating Homes of Marine Animals.*—The pelagic zone may be divided into several geographical regions and subregions, which it would be beyond the scope of this book to enumerate here, but there is one that calls for a few brief remarks. In many parts of the ocean there may be found vast areas of floating seaweed [sargasso] which carry with them a population of *Crustacea* and other animals peculiarly their own. This Sargasso fauna presents so many characteristics and so many features different from that of the ordinary pelagic fauna that the tracts of sea bearing this weed must be considered to rank as a special region of the pelagic zone, which may be called the "Sargasso region."—HICKSON *Fauna of the Deep Sea*, ch. 3, p. 48. (A., 1894.)

1774. ISOLATION OF OUR SUN—*Distance from Alpha Centauri—Seventy-five Million Years by Express Train.*—Our sun, a star in the immensity, is isolated in infinitude, and the nearest sun reigns at 10 trillions of leagues (25 billions of miles) from our terrestrial abode. Notwithstanding its unimaginable velocity of 186,400 miles a second, light moves, flies, during four years and 128 days to come from this sun to us. Sound would take more than 3 millions of years to cross the same abyss. At the constant velocity of 60 kilometers (37 miles) an hour an express train starting from the sun Alpha Centauri would not arrive here till after an uninterrupted course of nearly 75 millions of years.—FLAMMARION *Popular Astronomy*, bk. v, ch. 5, p. 599. (A.)

1775. ——— ——— *Independence of Each Sun in Its Own Domain.*—Thus our sun and the neighboring suns are isolated. Each is an independent king in its own province, and if they feel each other across the infinite, and are subject to the influence of their reciprocal attraction, it is but a suzerainty of little effect. The motions

which animate them are of an order superior to their respective attractions.—FLAMMARION *Popular Astronomy*, bk. vi, ch. 5, p. 600. (A.)

1776. ISOLATION OF SEQUOIAS—*Origin of the Redwood Mysterious.*—One notable thing about the sequioa-trees is their isolation. Most of the trees associated with them are of peculiar species, and some of them are nearly as local. Yet every pine, fir, and cypress of California is in some sort familiar, because it has near relatives in other parts of the world. But the redwoods have none. The redwood—including in that name the two species of "big trees"—belongs to the general cypress family, but is *sui generis*. Thus isolated systematically, and extremely isolated geographically, and so wonderful in size and port, they more than other trees suggest questions.—GRAY *Darwiniana*, art. 5, p. 208. (A., 1899.)

1777. ISOLATION OF THE SOLAR SYSTEM—*Stellar Distances.*—The solar system seems to us very vast, the abyss which separates our world from Mars, Jupiter, Saturn, and Neptune appears to us immense; relatively to the fixed stars, however, our whole system represents but an isolated family immediately surrounding us; a sphere as vast as the whole solar system would be reduced to the size of a simple point if it were transported to the distance of the nearest star. The space which extends between the solar system and the stars, and which separates the stars from each other, seems to be entirely void of visible matter, with the exception of nebulous fragments, cometary or meteoric, which circulate here and there in the immense voids. Nine thousand two hundred and fifty systems like ours (bounded by Neptune) would be contained in the space which isolates us from the nearest star!

If a terrible explosion occurred in this star, and if the sound could traverse the void which separates it from us, this sound would take more than three millions of years to reach us.—FLAMMARION *Popular Astronomy*, bk. vi, ch. 1, p. 553. (A.)

1778. JOURNEY THROUGH TRACKLESS SPACE—*Migration of Oriole and Bobolink.*—The oriole, who builds his swinging nest in your elm-tree, will winter in Central America; the bobolink, who seems so carefree in your meadows, must journey to his winter quarters in southern Brazil. But, unless accident befalls, both birds will return to you the following spring. We are so accustomed to these phenomena that we accept them as part of the changing seasons without realizing how wonderful they are. But look for a moment at a map and try to form a mental picture of the bobolink's route. Over valleys, mountains, marshes, plains, and forests, over straits and seas hundreds of miles in width, he pursues a course through trackless space with a regularity and certainty which bring him to the same place at nearly the same time year after year. How much of his knowledge of the route he has inherited, and how much learned during his own lifetime, is a question.—CHAPMAN *Bird-Life*, ch. 4, p. 54. (A., 1900.)

1779. JOY EXALTS AS GRIEF DEPRESSES—*Muscles, Arteries, and Nutrition Affected by Mental States.*—The familiar observations—first, that a lively hope or joy exerts an enlivening effect upon the bodily life, quiet and equable when moderate, but, when stronger, evinced in the brilliancy of the eye, in the quickened pulse and respiration, in an inclination to laugh and sing; and, secondly, that grief or other depressing passion has an opposite effect, relaxing the arteries, enfeebling the heart, making the eye dull, impeding digestion, and producing an inclination to sigh and weep—these familiar observations of opposite effects indicate the large part which mental states may play, not in the causation of all sorts of diseases alone, but in aiding recovery from them. A sudden and great mental shock may, like a great physical shock, and perhaps in the same way, paralyze for a time all the bodily and mental functions, or cause instant death. It may, again, produce epilepsy, apoplexy, or insanity, while a prolonged state of depression and anxiety is sometimes an important agent in the causation of chronic disease, such as diabetes and heart-disease. Can it be doubted, too, that the strong belief that a bodily disorder will be cured by some appliance, itself innocent of good or harm, may so affect beneficially the nutrition of the part as actually to effect a cure? To me it seems not unreasonable to suppose that the mind may stamp its tone, if not its very features, on the individual elements of the body, inspiring them with hope and energy, or infecting them with despair and feebleness.—MAUDSLEY *Body and Mind*, lect. 1, p. 38. (A., 1898.)

1780. JOY OF DISCOVERY—There is a certain form of emotion called intellectual pleasure which may be excited by poetry, literature, Nature, or art. But I doubt whether among the pleasures of the intellect there is any more pure and concentrated than that experienced by the scientific man when a difficulty which has challenged the human mind for ages melts before his eyes and recrystallizes as an illustration of natural law.—TYNDALL *New Fragments*, p. 202. (A., 1897.)

1781. JOY OR SORROW EXAGGERATED IN MEMORY—*Minds Differ in Choice of Images Retained.*—Besides the impossibility of getting at the average and prevailing mental tone of a distant section of life, there is a special difficulty in determining the degree of happiness of the past, arising from the fact that our memory for pleasures and for pains may not be equally good. Most people, perhaps, can recall the enjoyments of the past much more vividly than

the sufferings. On the other hand there seem to be some who find the retention of the latter the easier of the two. This fact should not be forgotten in reading the narrative of early hardships which some recent autobiographies have given us.—SULLY *Illusions*, ch. 10, p. 264. (A., 1897.)

1782. JUDGMENT OF INTENSITY OF SENSATION—*Quantitative, but with No Degrees—Merely "More" or "Less."*—If we compare with each other two different sensations of the same modality we are undoubtedly able to pass judgment regarding their intensities. Our judgment runs either: the sensations are of equal intensity, or, they are not of equal intensity. The midday sun we assert to be brighter than the moon, the roar of a cannon louder than the crack of a pistol, a hundredweight heavier than a pound. These comparative judgments are taken directly from sensation. We really state in them merely this: that the sensations which the sunshine, the cannon, and the hundredweight arouse in us are more intensive than the sensations which we have from the moon, a pistol-shot, or a poundweight. There is therefore possible a quantitative comparison of sensations. We can say of two sensations that they are of equal intensity, or that this one is of a greater or less intensity than the other. There our measurement of sensation ordinarily rests. We are not able to say how much stronger or how much weaker one is than another. We cannot estimate in the least whether the sun is a hundred or a thousand times brighter than the moon, the cannon a hundred or a thousand times louder than the pistol. Our ordinary measurement of sensation tells us only of "equality," of a "more" or of a "less," never of a "so much more" or "less."—WUNDT *Psychology*, lect. 2, p. 17. (Son. & Co., 1896.)

1783. KAIAK VERSUS OCEAN STEAMER—What is more beautiful than an ocean steamer, with skin of steel drawn over ribs of steel and closed above against the intrusion of the waves? Have you never seen the picture of the Eskimo, still in the Stone Age, who, over a framework of driftwood or whale's rib, stretches a covering of sealskin and learned therein to defy the waves hundreds of years ago?—MASON *The Birth of Invention (Address at Centenary of American Patent System, Washington, D. C., 1891, Proceedings of the Congress*, p. 407).

1784. KINDRED WITH THE DIVINE—*Kinship with Beasts Cannot Satisfy the Soul—Exaltation by Influence of Higher Intelligence—The Dog and His Master.*—They that deny a God destroy a man's nobility; for certainly man is of kin to the beasts by his body; and if he be not of kin to God by his spirit, he is a base and ignoble creature. It destroys likewise magnanimity, and the raising of human nature; for take an example of a dog, and mark what a generosity and courage he will put on when he finds himself maintained by a man, who to him is instead of a god, or "*melior natura*"; which courage is manifestly such as that creature, without that confidence of a better nature than his own, could never attain. So man, when he resteth and assureth himself upon divine protection and favor, gathereth a force and faith, which human nature in itself could not obtain; therefore, as atheism is in all respects hateful, so in this, that it depriveth human nature of the means to exalt itself above human frailty.—BACON *Essays*, essay 16, *Of Atheism*, p. 61. (W. L. A.)

1785. KINGDOM, DISTINCT, REQUIRED FOR PSYCHOLOGICAL MAN—*Gulf between Man and Ape.*—Mr. Mivart has truly said that, with regard to their total value in Nature, the difference between man and ape transcends the difference between ape and blade of grass. I should be disposed to go further and say that while for zoological man you can hardly erect a distinct family from that of the chimpanzee and orang, on the other hand, for psychological man you must erect a distinct kingdom; nay, you must even dichotomize the universe, putting man on one side and all things else on the other.—FISKE *Through Nature to God*, pt. ii, ch. 5, p. 82. (H. M. & Co., 1900.)

1786. KITCHEN, THE, A CHEMICAL LABORATORY — *Crude Materials Transformed for Food.*—The kitchen is a chemical laboratory in which are conducted a number of chemical processes by which our food is converted from its crude state to a condition more suitable for digestion and nutrition, and made more agreeable to the palate.—WILLIAMS *Chemistry of Cookery*, ch. 1, p. 4. (A., 1900.)

1787. KLEPTOMANIA A REAL INSANITY—*Hoarding of Useless Treasures.*—Kleptomania, as it is called, is an uncontrollable impulse to appropriate, occurring in persons whose "associations of ideas" would naturally all be of a counteracting sort. Kleptomaniacs often promptly restore or permit to be restored what they have taken; so the impulse need not be to keep, but only to take. But elsewhere hoarding complicates the result. A gentleman with whose case I am acquainted was discovered, after his death, to have a hoard in his barn of all sorts of articles, mainly of a trumpery sort, but including pieces of silver which he had stolen from his own dining-room, and utensils which he had stolen from his own kitchen, and for which he had afterward bought substitutes with his own money.—JAMES *Psychology*, vol. ii, ch. 24, p. 425. (H. H. & Co., 1899.)

1788. KNIVES OF SHARKS' TEETH—*Gain Attending the Iron Blade.*—It will be found in the study of industrial knives that in the long run they become the

carver's and engraver's tools, the drawing-knife, the spoke-shave, the plane, and the planing-mill. In some styles of the last-named, however, the operative part of the machine is, more properly speaking, a machine adz than a knife. Carving in wood and other substances by the American aborigines differentiated the adz from the knife. It is probable that before the introduction of iron into America the adz was used more than the knife in dressing down wood; but when the iron blade came into vogue it was possible for the savage workman to carve out hollow dishes and boxes and other objects with his knife by simple pressure. Notable exceptions to this are those regions where soft wood came into alliance with sharks' teeth and the incisors of rodents. This is shown in all the curved knives of the collections in the United States National Museum from the two hemispheres, especially those from wooded areas.—MASON *The Man's Knife among the North American Indians (Report of U. S. National Museum for 1897,* p. 727).

1789. KNOWLEDGE ACQUIRED BY LEARNING TO DOUBT—*Boiling of Food for the Table—Cooking of Food Man's Immemorial Custom.*—"The process by which food is most commonly prepared for the table—boiling—is so familiar to every one, and its effects are so uniform and apparently so simple, that few, I believe, have taken the trouble to inquire how or in what manner these effects are produced; and whether any, and what, improvements in that branch of cookery are possible. So little has this matter been an object of inquiry that few, very few, indeed, I believe, among the millions of persons who for so many ages have been daily employed in this process have ever given themselves the trouble to bestow one serious thought upon the subject.

"The cook knows from experience that if his joint of meat be kept a certain time immersed in boiling water it will be done, as it is called in the language of the kitchen; but if he be asked what is done to it, or how or by what agency the change it has undergone has been effected—if he understands the question—it is ten to one but he will be embarrassed. If he does not understand he will probably answer without hesitation, that 'The meat is made tender and eatable by being boiled.' Ask him if the boiling of the water be essential to the process. He will answer, 'Without doubt.' Push him a little further by asking him whether, were it possible to keep the water equally hot without boiling, the meat would not be cooked as soon and as well as if the water were made to boil. Here it is probable he will make the first step towards acquiring knowledge by learning to doubt."—COUNT RUMFORD, quoted by WILLIAMS in *Chemistry of Cookery,* ch. 2, p. 16. (A., 1900.)

1790. KNOWLEDGE, ANCIENT, OF THE HEAVENS — *Constellations Gradually Arranged.*—The primitive Greek sphere had become gradually filled with constellations, without being in any degree considered with relation to the ecliptic. Thus Homer and Hesiod designate by name individual stars and groups; the former mentions the constellation of the Bear ("otherwise known as the Celestial Wain, and which alone never sinks into the bath of Oceanos"), Bootes, and the Dog of Orion; the latter speaks of Sirius and Arcturus, and both refer to the Pleiades, the Hyades, and Orion. Homer's twice-repeated assertion, that the constellation of the Bear alone never sinks into the ocean, merely allows us to infer that in his age the Greek sphere did not yet comprise the constellations of Draco, Cepheus, and Ursa Minor, which likewise do not set. The statement does not prove a want of acquaintance with the existence of the separate stars forming these three catasterisms, but simply an ignorance of their arrangement into constellations. A long and frequently misunderstood passage of Strabo . . . specially proves . . . that in the Greek sphere the stars were only gradually arranged in constellations. Homer has been unjustly accused of ignorance, says Strabo, as if he had known of only one instead of two Bears. It is probable that the lesser one had not yet been arranged in a separate group, and that the name did not reach the Hellenes until after the Phenicians had specially designated this constellation, and made use of it for the purposes of navigation.—HUMBOLDT *Cosmos,* vol. iii, p. 119. (H., 1897.)

1791. KNOWLEDGE AND BELIEF —*Comparison to House and Furniture.*—Our beliefs must be carefully distinguished from our knowledge; and they seem to me to bear much the same relation to it that our furniture has to the building in which we put it. The walls are or ought to be solid and enduring; so is everything that deserves to be called knowledge. Each stone supports and is supported by the rest; and nothing but a weakness of its foundation or a decay of its material can make our fabric of thought uninhabitable. But the beliefs with which we furnish it have not the same durability. Adapted to meet our temporary needs, they may be either poor in material or but slightly put together. A carpet wears out, and, when past shifting and patching, must be replaced by a new one; a table or a chair breaks down, and, after successive repairs, is discarded as no longer serviceable. Or perhaps our requirements change; and some article which was at first made expressly in accordance with them proves no longer suitable to our needs; so that, finding it in our way, we wish to get rid of it. Some pieces of our furniture, again, originally of more substantial make, have become faded and old-fashioned; but they may be family heir-

looms, or we may have ourselves become attached to them; and so, not liking to discard them altogether, we put them away in some dark corner, or perhaps consign them to a seldom-visited lumber-room, where they rest almost forgotten in their obscurity. But at last some ray of sunshine throws a brighter light than usual upon our dark corner; or the opening of the shutters of our lumber-room lets into it the unwonted light of day; and we then find our old sofas and four-post beds so moth-eaten and decayed that we turn them out of our house instanter.—CARPENTER *Nature and Man*, lect. 7, p. 215. (A., 1889.)

1792. KNOWLEDGE A SAFEGUARD —*Biology Guards the Young against Pitfalls.*—If, however, the study of life-science has one prominent advantage over all other studies, it is that in its nature it acts most powerfully in bringing the present world and its constitution plainly and vividly before the eyes of boys and girls. It excites their interest in life and living things; it suggests trains of thought which extend almost into every department of knowledge which has a claim on human sympathy and regard. And it can provide the young with that knowledge of themselves which is the surest safeguard against the numerous pitfalls that in this exhausting age threaten the physical and mental health at every epoch of life.—ANDREW WILSON *Biology in Education*, p. 24. (Hum., 1888.)

1793. KNOWLEDGE, HUMAN, LIMITATIONS OF—*Science Enforces Lesson of Experience—Unseen Forces Control the World.*—It is evident that all the effects of the events with which we are concerned are not and could not possibly be perceived by us. We see and feel things—alike the great ones and the small ones, as we esteem them —only as they affect our senses; that is, only in small part and for a short time. They soon pass beyond our sight, and while they are within it they never show us all they are, often those which are the greatest seeming to us the least. How little we are able, often, to calculate the influence even upon our own future of events or actions of which we seem to have the most perfect knowledge at the time. And of the effects of these events on others, which must go on, so far as we can estimate, without any end, only the smallest fragment is within our view. It is one of the first lessons taught men by experience, not to judge of events by what they seem alone, but to remember that there may be much more involved in them than appears. To judge of our life, therefore, merely by that which is seen of it, is to commit ourselves to certain error. . . .

And this principle is established not only by experience; it is the lesson which, almost more than any other, science teaches us also. In exploring the material world, we soon find that, in order to understand any part of it aright, we must recognize things which are unseen, and have regard to conditions or to actions which do not come within our direct perception. It is enough to instance the pressure of the air, of which we have no consciousness; the motion of the earth, equally unperceivable by us; the hidden force, lurking in unseen atoms, of chemical affinity, or electricity; the vibrations which traverse the universal ether; and, in fine, that invisible unity which makes all her forces one, whereby (holding to the unseen) man has traced out in Nature a perfect order amid all confusion.—HINTON *The Mystery of Pain*, p. 15. (Hum., 1893.)

1794. ——— ——— *Tentative Explanations Alone Yet Possible of Volcanic Phenomena.*—That these operations, like all others going on upon the globe, are governed by great natural laws we cannot for a moment doubt. And that, in all probability, more careful and exact observation and reasoning will at some future time lead us to the recognition of these laws, every student of Nature is sanguine. But at the present time, it must be confessed, we are very far indeed from being able to afford that crowning proof of the truth of our theories of volcanic action which is implied in the power of predicting the period and degree of intensity of their manifestations. —JUDD *Volcanoes*, ch. 2, p. 32. (A., 1899.)

1795. KNOWLEDGE IS POWER— *For Nations as Well as Individuals.*—Bacon has said that, in human societies, knowledge is power. Both must rise and sink together. But the knowledge that results from the free action of thought is at once the delight and the indestructible prerogative of man; and in forming part of the wealth of mankind, it not unfrequently serves as a substitute for the natural riches, which are but sparingly scattered over the earth. Those states which take no active part in the general industrial movement, in the choice and preparation of natural substances, or in the application of mechanics and chemistry, and among whom this activity is not appreciated by all classes of society, will infallibly see their prosperity diminish in proportion as neighboring countries become strengthened and invigorated under the genial influence of arts and sciences.—HUMBOLDT *Cosmos*, vol. i, int., p. 53. (H., 1897.)

1796. KNOWLEDGE LIMITED BY PRECONCEPTIONS—When the question of the range of consciousness was first raised, these conditions [of the subjective and objective limitations of knowledge] were entirely overlooked, and the general method of investigation pursued was not one which could lead to any certain results. Conclusions were either deduced from certain metaphysical postulates—*e. g.*, that the mind, as a simple being, could only contain a single idea at a given moment—or the investigations were based solely on introspection.—WUNDT *Psychology*, lect. 16, p. 240. (Son. & Co., 1896.)

1797. KNOWLEDGE MADE PRACTICAL—*Daguerreotype Founded on Old-time Discovery.*—The fact that certain salts of silver were darkened by exposure to sunlight was known to the alchemists in the sixteenth century, and this observation forms the rudiment from which the whole art has been developed. The application of this fact to the production of pictures belongs, however, wholly to our own time. In the year 1802, Wedgewood described a mode of copying paintings on glass by exposure to light, but neither he nor Sir Humphry Davy could find any means of rendering the copies permanent. This was first effected in 1814 by M. Niepce, of Châlons, but no important results were obtained till 1839, when Daguerre perfected the beautiful process known as the daguerreotype. Permanent portraits were taken by him on silvered plates, and they were so delicate and beautiful that probably nothing in modern photography can surpass them. For several years they were the only portraits taken by the agency of light, but they were very costly, and were therefore completely superseded when cheaper methods were discovered.—WALLACE *The Wonderful Century,* ch. 5, p. 32. (D. M. & Co., 1899.)

1798. KNOWLEDGE, MAN YET BUT ON THRESHOLD OF—"*We Are Ancients of the Earth, in the Morning of the Times.*"* —We are in reality but on the threshold of civilization. Far from showing any indication of having come to an end, the tendency to improvement seems latterly to have proceeded with augmented impetus and accelerated rapidity. Why, then, should we suppose that it must now cease? Man has surely not reached the limits of his intellectual development, and it is certain that he has not exhausted the infinite capabilities of Nature. There are many things which are not as yet dreamt of in our philosophy: many discoveries which will immortalize those who make them, and confer upon the human race advantages which as yet, perhaps, we are not in a condition to appreciate. We may still say with our great countryman, Sir Isaac Newton, that we have been but like children playing on the seashore, and picking up here and there a smoother pebble or a prettier shell than ordinary, while the great ocean of truth lies all undiscovered before us.—AVEBURY *Prehistoric Times,* ch. 16, p. 575. (A., 1900.)

1799. KNOWLEDGE NOT SUFFICIENT FOR CONDUCT—*Right Desire the Chief Need.*—Right conduct is usually come short of more from defect of will than defect of knowledge. For the right coordination of those complex actions which constitute human life in its civilized form, there goes not only the prerequisite, recognition of the proper course, but the further prerequisite, a due impulse to pursue that course. On calling to mind our daily failures to fulfil often-repeated resolutions, we shall perceive that lack of the needful desire, rather than lack of the needful insight, is the chief cause of faulty action.—SPENCER *Biology,* pt. vi, ch. 13, p. 525. (A., 1900.)

1800. KNOWLEDGE OF FIRE UNIVERSAL AMONG MEN—It cannot be said to be satisfactorily proved that there is at present, or has been within historical times, any race of men entirely ignorant of fire. It is at least certain that as far back as the earliest Swiss lake villages and Danish shell-mounds the use of fire was well known in Europe.—AVEBURY *Prehistoric Times,* ch. 15, p. 535. (A., 1900.)

1801. "KNOWLEDGE OF THE CONSTRUCTION OF THE HEAVENS"—*The Ambition of the Elder Herschel—The Inquiring Spirit of Man.*—When we look around us into the regions which surround the solar system and see the myriads of myriads of stars which are spread through space, it is impossible not to feel strongly the desire to penetrate the mystery of the star-strewn depths. We have learned much respecting the earth on which we live, and not a little of the system to which the earth belongs. We have at least so far solved the problems presented to us by the planetary scheme as to recognize the subordinate position which our earth holds within it, and that the sun is the mighty ruler whose sway guides all the planets in their courses. But the inquiring spirit of man is not satisfied with these discoveries. No sooner has he learned to regard the earth as but one of a system of worlds circling round the sun, and that that system has such and such proportions, and presents such and such forms of motion, than he desires to regard our sun as but one of a system of suns, and to ascertain what may be the nature and the scale of this higher system, what the movements taking place within it. This was the noble problem which the elder Herschel set as the great end and aim of all his labors: "A knowledge of the construction of the heavens," he said, towards the end of his wonderful career as an observer, "has always been the ultimate object of my observations."—PROCTOR *Expanse of Heaven,* p. 256. (L. G. & Co., 1897.)

1802. LABOR ESSENTIAL TO HUMAN PROGRESS—*Rigorous Climates Stimulate—Improvement in Conditions and Results of Work—Evil with Good.*—We do not wish to draw upon ourselves the imputation of advocating the inevitable progress of the human race. The world is subject to evil

* "To sleep through terms of mighty wars,
And wake on science grown to more,
On secrets of the brain, the stars,
As wild as aught of fairy lore;
And all that else the years will show;
. . . . .
"Titanic forces taking birth
In divers seasons, divers climes,
For we are Ancients of the earth,
And in the morning of the times."
—TENNYSON *The Day-Dream, L'Envoi,* st. 1, ll. 9-20.

impressions as well as good, and whatever advance is made in the line of true progress will not be the result of a blind law of necessity, but of a providential design through human agency and properly directed human labor. Without labor nothing of value can be accomplished. It is the essential prerequisite of well-being, the original curse which proves a blessing in disguise. The remark has been properly made, that could all the wants of man be supplied without labor, there would be reason to fear that he would become a brute for the want of something to do, rather than a philosopher from an abundance of leisure. In all countries where Nature does the most, man does the least. The sterile soil and the inclement sky seem to be the stimulants to mental and physical exertion when once the necessary impulse has been given. True progress does not consist in obviating the necessity of labor, but in changing, by means of improvements in the arts, its character, in rendering it more conducive to the supply of the wants and comforts of man, and to the development of his mental and moral nature.—HENRY *Improvement of the Mechanical Arts (Scientific Writings,* vol. i, p. 323). (Sm. Inst., 1886.)

1803. LABOR, FALLACIES REGARDING—*"Free Labor" Often a Misnomer—Competition Despotic.*—Had not the working classes a right to employ their children as they pleased? Who were better able to judge, than fathers and mothers, of the capacities of their children? Why interfere for the protection of those who already had the best and most natural of all protections? Such were some of the arguments against interfering with "free labor." Now in what sense was this labor free? It was free from legal compulsion—that is to say, it was free from that kind of compulsion which arises out of the public will of the whole community imposed by authority upon the conduct of individuals. But there was another kind of force from which this labor was not free—the force of overpowering motive operating on the will of the laborers themselves. If one parent, more careful than others of the welfare of his children, and moved less exclusively by the desire of gain, withdrew his children at an earlier hour than others from factory work, his children were liable to be dismissed and not employed at all. On the other hand, motives hardly less powerful were in constant operation on the masters. The ceaseless, and increasing, and unrestricted competition amongst themselves—the eagerness with which human energies rush into new openings for capital, for enterprise, and for skill—made them, as a class, insensible to the frightful evils which were arising from that competition for the means of subsistence which is the impelling motive of labor. —ARGYLL *Reign of Law,* ch. 7, p. 210. (Burt.)

1804. LACK OF EVIDENCE NOT IMPEACHMENT OF EVIDENCE—*Manifest Adjustment Stands as Fact.*—The relations of adjustment between a given number of elements are none the less a certain fact because similar elements may be found elsewhere without any such adjustment being visible to us. It is the very fact of their not being separate, but combined, in the one case which justifies and compels a conclusion different from that which arises in the other case. This is the law of evidence on which we act and judge in other matters with conviction which is both intuitive and capable of being confirmed by the rules of reason. And this reply is applicable to all objections of the same kind. Those portions of the system of Nature which are wholly dark to us do not necessarily cast any shadow on those other portions of that system which are luminous with inherent light. Rather the other way. The shining tracts which thus reflect the light of reason and of mind send abundant rays into all the dark places round them.—ARGYLL *Reign of Law,* ch. 1, p. 21. (Burt.)

1805. LAKE-DWELLINGS OF LIVING PEOPLE—One feature in their [the Amazonian Indians'] mode of building deserves to be mentioned. Owing to the submerged state of the ground on which they live the Indians often raise their houses on piles sunk in the water. Here we have the old lacustrine buildings, so much discussed of late years, reproduced for us. One even sees sometimes a little garden lifted in this way above the water.—AGASSIZ *Journey in Brazil,* ch. 5, p. 162. (H. M. & Co., 1896.)

1806. LAKES HAVE LIFE-HISTORIES—*Duration Varying from a Day to Ages—The Oldest Lake Recent for the Geologist.*—Lakes, like mountains and rivers, have life-histories which exhibit varying stages from youth through maturity to old age. The span of their existence varies as do the lives of animals and plants. In arid regions they are frequently born of a single shower and disappear as quickly when the skies are again bright; their brief existence may be said to resemble the lives of the *Ephemera.* Again, the conditions are such that lakes perhaps hundreds of square miles in area are formed each winter, and evaporate to dryness during the succeeding summer; these may be compared with the annual plants, so regular are their periods. Still others exist for a term of years and only disappear during seasons of exceptional aridity; but the greater number of inland water bodies resemble the Sequoia and endure for centuries with but little apparent change. So long are the lives of many individuals that human history has recorded only slight changes in their outlines, but to the geologist even these are seen to be of recent origin and the day of their extinction not remote. —RUSSELL *Lakes of North America,* int., p. 7. (G. & Co., 1895.)

1807. LAMPS, CLASSICAL AND SAVAGE, ESSENTIALLY THE SAME—In all essential particulars the Eskimo woman's lamps at Bristol Bay are similar to the ones tended long ago in the Prytaneum at Athens and in the Temple of Vesta at Rome; and many hundreds of extremely rude examples are now in use all about the lands bordering on the Mediterranean.—MASON *Woman's Share in Primitive Culture,* ch. 5, p. 92. (A., 1894.)

1808. LAND, DWELLERS ON—*Changes beneath Sea Hard to Imagine—Stone Quarried for Distant Building.*—The first and greatest difficulty, then, consists in an habitual unconsciousness that our position as observers is essentially unfavorable when we endeavor to estimate the nature and magnitude of the changes now in progress. In consequence of our inattention to this subject we are liable to serious mistakes in contrasting the present with former states of the globe. As dwellers on the land, we inhabit about a fourth part of the surface, and that portion is almost exclusively a theater of decay and not of reproduction. We know, indeed, that new deposits are annually formed in seas and lakes, and that every year some new igneous rocks are produced in the bowels of the earth, but we cannot watch the progress of their formation; and as they are only present to our minds by the aid of reflection, it requires an effort both of the reason and the imagination to appreciate duly their importance. It is, therefore, not surprising that we estimate very imperfectly the result of operations thus invisible to us; and that, when analagous results of former epochs are presented to our inspection we cannot immediately recognize the analogy. He who has observed the quarrying of stone from a rock, and has seen it shipped for some distant port, and then endeavors to conceive what kind of edifice will be raised by the materials, is in the same predicament as a geologist who, while he is confined to the land, sees the decomposition of rocks and the transportation of matter by rivers to the sea, and then endeavors to picture to himself the new strata which Nature is building beneath the waters.—LYELL *Principles of Geology,* bk. i, ch. 5, p. 68. (A., 1854.)

1809. LAND FROM BENEATH THE WATERS *(Gen. i, 9; Ps. civ. 6-7).*—It results from the simplest methods of interpretation that, leaving out of view certain patches of metamorphosed rocks and certain volcanic products, all that is now dry land has once been at the bottom of the waters. It is perfectly certain that at a comparatively recent period of the world's history—the Cretaceous epoch—none of the great physical features which at present mark the surface of the globe existed. It is certain that the Rocky Mountains were not. It is certain that the Himalaya Mountains were not. It is certain that the Alps and the Pyrenees had no existence. The evidence is of the plainest possible character, and is simply this: We find raised up on the flanks of these mountains, elevated by the forces of upheaval which have given rise to them, masses of cretaceous rock which formed the bottom of the sea before those mountains existed. It is therefore clear that the elevatory forces which gave rise to the mountains operated subsequently to the Cretaceous epoch, and that the mountains themselves are largely made up of the materials deposited in the sea which once occupied their place.—HUXLEY *American Addresses,* lect. 1, p. 27. (A., 1898.)

1810. LANDSCAPE, PHYSIOGNOMY OF—*Each Geological Formation Marked by Features of Its Own.*—Physiognomy is no idle or doubtful science in connection with geology. The physiognomy of a country indicates, almost invariably, its geological character. There is scarce a rock among the more ancient groups that does not affect its peculiar form of hill and valley. Each has its style of landscape; and as the vegetation of a district depends often on the nature of the underlying deposits, not only are the main outlines regulated by the mineralogy of the formations which they define, but also in many cases the manner in which these outlines are filled up. The coloring of the landscape is well-nigh as intimately connected with its geology as the drawing.—MILLER *Old Red Sandstone,* ch. 11, p. 190. (G. & L., 1851.)

1811. LANDS, REMOTE, VISITED BY MIGRATING BIRDS—*Desolation of Arctic Regions in Winter.*—The chimney-swallow which in October was twittering under the eaves of the manor-house in Kent may possibly be recognizing the squire as he suns himself in the Algerine town which they have both chosen for their winter quarters, and the night-jar, which was in such a hurry to leave us that she had no time to build a nest, is perhaps a week after taking her departure from Surrey comparing notes with her vocal rivals among those palmetto groves beyond which peep the minarets of the Great Mosque of Morocco. In July every arctic cliff is moving with bird life; by October or November, at latest, the raven and the snowy owl are almost the only fowls left to give a semblance of the busy world to the snow wastes glittering under the cold moon and the weird-like northern lights.—BROWN *Nature-Studies,* p. 14. (Hum., 1888.)

1812. LANGUAGE AMONG THE LOWER ANIMALS—*Cooperation Involves Language—Rapid Communication among Ants—Antenna Language.*—Any means by which information is conveyed from one mind to another is language. And language existed on the earth from the day that animals began to live together. The mere fact that animals cling to one another, live together, move about together, proves that

they communicate. Among the ants, perhaps the most social of the lower animals, this power is so perfect that they are not merely endowed with a few general signs, but seem able to convey information upon matters of detail. Sweeping across country in great armies they keep up communication throughout the whole line, and succeed in conveying to one another information as to the easiest routes, the presence of enemies or obstacles, the proximity of food supplies, and even of the numbers required on emergencies to leave the main band for any special service. Every one has observed ants stop when they meet one another and exchange a rapid greeting by means of their waving antennæ, and it is possibly through these perplexing organs that definite intercourse between one creature and another first entered the world. The exact nature of the antenna language is not yet fathomed, but the perfection to which it is carried proves that the idea of language generally has existed in Nature from the earliest time.—DRUMMOND *Ascent of Man*, ch. 5, p. 157. (J. P., 1900.)

1813. LANGUAGE A SOURCE OF MYTH—*Confusion of Name Leads to Confusion of Nature—The Bernicle-tree and Its Progeny of Geese.*—Professor Max Müller, after discussing various theories of the origin of the barnacle myth [of the production of geese from barnacles] declares in favor of the idea that confusion of language and alteration of names lie at the root of the error. The learned author of the "Science of Language" argues that the true barnacles were named, properly enough, *Bernaculæ*, and lays stress on the fact that bernicle geese were first caught in Ireland. That country becomes *Hibernia* in Latin, and the Irish geese were accordingly named *Hibernicæ* or *Hiberniculæ*. By the omission of the first syllable—no uncommon operation for words to undergo—we obtain the name *Berniculæ* for the geese, this term being almost synonymous [or rather homonymous] with the name *Bernaculæ* already applied, as we have seen, to the barnacles. Bernicle-geese and bernicle-shells, confused in name, thus became confused in Nature; and, once started, the ordinary process of growth was sufficient to further intensify and render more realistic the story of the bernicle-tree and its wonderful progeny.—WILSON *Facts and Fictions of Zoology*, p. 8. (Hum., 1882.)

1814. LANGUAGE BANKS THE GAINS OF INTELLECT—*Progress Transmitted by Speech as Not by Heredity.*—When it is asked, What brought about this sudden rise of intelligence in the case of man? there is a wonderful unanimity among men of science as to the answer. It came about, it is supposed, in connection with the acquisition by man of the power to express his mind, that is to *speak*. Evolution, up to this time, had only one way of banking the gains it won—heredity. To hand on any improvement physically was a slow and precarious work. But with the discovery of language there arose a new method of passing on a step in progress. Instead of sowing the gain on the wind of heredity, it was fastened on the wings of words. The way to make money is not only to accumulate small gains steadily, but to put them out at a good rate of interest. Animals did the first with their mental acquisitions: man did the second. At a comparatively early date he found out a first-rate and permanent investment for his money, so that he could not only keep his savings and put them out at the highest rate of interest, but have a share in all the gain that was made by other men. That discovery was language.—DRUMMOND *Ascent of Man*, ch. 4, p. 150. (J. P., 1900.)

1815. LANGUAGE, BRUTES ATTAIN ONLY RUDIMENTS OF—*Word as Sign of Idea Only in Human Mind.*—As yet, however, no observer has been able to follow the workings of mind even in the dog that jumps up for food and barks for the door to be opened. It is hard to say how far the dog's mind merely associates jumping up with being fed, and barking with being let in, or how far it forms a conception like ours of what it is doing and why it does it. Anyhow, it is clear that the beasts and birds go so far in the natural language as to make and perceive gestures and cries as signals. But a dog's mind seems not to go beyond this point, that a good imitation of a mew leads it to look for a cat in the room; whereas a child can soon make out from the nurse saying "miaou" that she means something about some cat, which need not even be near by. That is, a young child can understand what is not proved to have entered into the mind of the cleverest dog, elephant, or ape, that a sound may be used as the sign of a thought or idea. Thus, while the lower animals share with man the beginnings of the natural language, they hardly get beyond its rudiments, while the human mind easily goes on to higher stages.—TYLOR *Anthropology*, ch. 4, p. 123. (A., 1899.)

1816. LANGUAGE CONTINUALLY GENERATED—*A Living Force—Writing vs. Speech.*—The true solution of the contrasting stability and fluctuation that we find in language lies in the unity of human nature. No one assigns to a word precisely the same meaning that another does, and a shade of meaning, be it ever so slight, ripples on like a circle in the water through the entirety of language. Even the preservation of a language by means of writing keeps it only in an incomplete way, mummy-like, in which it can only gain vitality by means of timely recitation. In itself it is not a completed work, but an internal energy in the soul begetting new creations.—WILHELM VON HUMBOLDT *Ueber die Verschiedenheit des menschlichen Sprachbaues und ihren Einfluss auf*

die geistige Entwickelung des Menschengeschlechts. (Translated for *Scientific Side-Lights.)*

1817. LANGUAGE CONTROLS CUSTOMS AND TRADE—The French language produces French habits, French habits introduce French products. Those who know French become the patrons of France.—*Bulletin de l'Alliance française.* (Translated for *Scientific Side-Lights.)*

1818. LANGUAGE, GRADUAL ACQUISITION OF—*Vocabulary of English Language—Number of Words in Common Use—Vocabulary Varies with Education.*—The vocabulary of a rich and long-cultivated language like the English may be roughly estimated at about 100,000 words (altho this excludes a great deal which, if "English" were understood in its widest sense, would have to be counted in): but thirty thousand is a very large estimate for the number ever used, in writing or speaking, by a well-educated man: three to five thousand, it has been carefully estimated, cover the ordinary needs of cultivated intercourse; and the number acquired by persons of lowest training and narrowest information is considerably less than this. Nowhere more clearly than here does it appear that one gets his language by a process of learning, and only thus: for all this gradual increase of one's linguistic resources goes on in the most openly external fashion, by dint of hearing and reading and study; and it is obviously only a continuation, under somewhat changed circumstances, of the process of acquisition of the first nucleus: while the whole is parallel to the beginning and growth of one's command of a "foreign" tongue.—WHITNEY *Life and Growth of Language,* ch. 2, p. 26. (A., 1900.)

1819. LANGUAGE INVOLVES ENTIRE MIND—*No Single Faculty Competent to the Work.*—Its [phrenology's] "faculties," as a rule, are fully equipped persons in a particular mental attitude. Take, for example, the "faculty" of language. It involves in reality a host of distinct powers. We must first have images of concrete things and ideas of abstract qualities and relations; we must next have the memory of words and then the capacity so to associate each idea or image with a particular word that, when the word is heard, the idea shall forthwith enter our mind. We must, conversely, as soon as the idea arises in our mind, associate with it a mental image of the word, and by means of this image we must innervate our articulatory apparatus so as to reproduce the word as physical sound. To read or to write a language, other elements still must be introduced. But it is plain that the faculty of spoken language alone is so complicated as to call into play almost all the elementary powers which the mind possesses—memory, imagination, association, judgment, and volition. A portion of the brain competent to be the adequate seat of such a faculty would needs be an entire brain in miniature—just as the faculty itself is really a specification of the entire man.—JAMES *Psychology,* vol. i, ch. 2, p. 28. (H. H. & Co., 1899.)

1820. LANGUAGE MADE MEANINGLESS BY AUTOMATIST THEORY—*"Ought" — "Duty" — "Responsibility"—Individual Deemed Victim of Circumstances.*—It seems to me . . . quite clear that on the automatist or determinist theory, such words as "ought," "duty," "responsibility," have to be used, if used at all, in new significations. The welfare of that aggregate of automata which we call "society" may require that every individual automaton shall be prevented from doing what is injurious to it; and punishment for offenses actually committed may be reasonably inflicted as a deterrent from the repetition of such offenses by the individual or by others. But if the individual has in himself no power either to do the right or to avoid the wrong, and if the potency of that aggregate of feelings about actions as being "right or wrong," which is termed "conscience," entirely depends upon "circumstances" over which he neither has nor ever has had any control, I fail to see in what other sense he should be held "responsible" for doing what he knows that he "ought not" to have done, or for not doing what he knows that he "ought" to have done, than a steam-engine, which breaks away from its "governor" in consequence of a sudden increase of steam-pressure, or which comes to a stop through the bursting of its steam-pipe, can be accounted responsible for the damage thence arising.—CARPENTER *Mental Physiology,* pref., p. 46. (A., 1900.)

1821. LANGUAGE MAKES KNOWLEDGE HEREDITARY—*The Son Begins Where the Father Ends.*—Language formed the trellis on which mind climbed upward, which continuously sustained the ripening fruits of knowledge for later minds to pluck. Before the savage's son was ten years old he knew all that his father knew. The ways of the game, the habits of birds and fish, the construction of traps and snares—all these would be taught him. The physical world, the changes of season, the location of hostile tribes, the strategies of war, all the details and interests of savage life would be explained. And before the boy was in his teens he was equipped for the struggle for life as his forefathers had never been even in old age. The son, in short, started to evolve where his father left off. Try to realize what it would be for each of us to begin life afresh, to be able to learn nothing by the experiences of others, to live in a dumb and illiterate world, and see what chance the animal had of making pronounced progress until the acquisition of speech.—DRUMMOND *Ascent of Man,* ch. 4, p. 152. (J. P., 1900.)

1822. LANGUAGE, MYSTERY OF— There could be no invention of language unless its type already existed in the human understanding. Man is man only by means of speech, but, in order to invent speech, he must be already man.—WILHELM VON HUMBOLDT *Einleitung, Ueber die Kawi-sprache auf der Insel Java.* (Translated for *Scientific Side-Lights.)*

1823. LANGUAGE OF ANIMALS MERELY RUDIMENTARY— Animals possess certain elements of language, just as they possess certain elements of consciousness which might serve as the basis of intellectual function, but they do not possess language itself. So that the mere absence of this external mark would justify us in inferring the absence of those mental functions of which it is the mark. As a rule, it is not any physical obstacle, as is so often thought, which prevents animals from talking. In very many animals the development of the organs of speech has gone far enough to enable them to clothe thought in words, if the thought were there to clothe. The question why the animals do not talk is most correctly answered in the old way—because they have nothing to say. Only we must add that certain movements and sounds characteristic of feelings and ideas seem to be the forerunners of language, and that animals give signs that in this connection, as in others, their mental life is the immediate precursor of our own.—WUNDT *Psychology,* lect. 24, p. 363. (Son. & Co., 1896.)

1824. LANGUAGE OF EXPRESSION, NATURAL— *Emotion Manifested through the Body.*—It has been noted in all ages and countries that the feelings possess a natural language or expression. So constant are the appearances characterizing the different classes of emotions that we regard them as a part of the emotions themselves. The smile of joy, the puckered features in pain, the stare of astonishment, the quivering of fear, the tones and glance of tenderness, the frown of anger, are united in seemingly inseparable association with the states of feeling that they indicate. If a feeling arises without its appropriate sign or accompaniment, we account for the failure either by voluntary suppression or by the faintness of the excitement, there being a certain degree or intensity requisite to affect the bodily organs. On this uniformity of connection between feelings and their bodily expression depends our knowledge of each other's mind and character. When any one is pleased, or pained, or loving, or angry, unless there is purposed concealment we are aware of the fact, and can even estimate in any given case the degree of the feeling.—BAIN *Mind and Body,* ch. 2, p. 2. (Hum., 1880.)

1825. LANGUAGE OF GESTURE— *Natural Signs Understood by All Races of Men.*—Communication by gesture signs between persons unable to converse in vocal language is an effective system of expression common to all mankind. Thus the signs used to ask a deaf-and-dumb child about his meals and lessons, or to communicate with a savage met in the desert about game or enemies, belong to codes of gesture signals identical in principle and to a great extent independent both of nationality and education; there is even a natural syntax, or order of succession, in such gesture signs. To these gestures let there be added the use of the interjectional cries, such as *oh! ugh! hey!* and imitative sounds to represent the cat's *mew,* the *click* of a trigger, the *clap* or *thud* of a blow, etc. The total result of this combination of gesture and significant sound will be a general system of expression, imperfect but serviceable, and naturally intelligible to all mankind without distinction of race. . . . The lower animals make no approach to the human system of natural utterance by gesture signs and emotional-imitative sounds, while the practical identity of this human system among races physically so unlike as the Englishman and the native of the Australian bush indicates extreme closeness of mental similarity throughout the human species. —DANIEL WILSON *Anthropology,* ch. 6, p. 22. (Hum., 1885.)

1826. LANGUAGE OF TOUCH— *Ants Communicate by Antennæ.*—Language is the key to the union we remark in this numerous family. It is not by means of sounds or visible signs, but by touch, that it manifests itself; it is especially the antennæ, those organs that distinguish insects from all other animals, that serve, whenever the species meets in society, the noble use of communicating impressions from one individual to another, their wishes, necessities, and the situation. No doubt the antennal language is imperfect, if compared with our requirements, but it suffices very well for ants.—HUBER *Recherches sur les Mœurs des Fourmis indigènes,* p. 310. (Translated for *Scientific Side-Lights.)*

1827. LANGUAGE, PLACE OF, IN EARLY EDUCATION— The several faculties of the human mind are not simultaneously developed, and in educating an individual we ought to follow the order of Nature, and to adapt the instruction to the age and mental stature of the pupil. If we reverse this order and attempt to cultivate faculties which are not sufficiently matured, while we neglect to cultivate those which are, we do the child an irreparable injury. Memory, imitation, imagination, and the faculty of forming mental habits exist in early life, while the judgment and the reasoning powers are of slower growth. It is a fact abundantly proved by observation that the mere child, by the principle which has been denominated sympathetic imitation, may acquire the power of expressing his desires and emotions in correct and even beautiful language without knowing or being able to comprehend the simplest principles

of philology. He even seizes, as if by a kind of instinct, upon abstract terms, and applies them with ease and correctness; but as life advances, the facility of verbal acquisition declines, and with some it entirely disappears. Hence the plan appears to me to be wise and in accordance with Nature, which makes the acquisition of language an essential part of early elemental education. The same child which acquires almost without effort his vernacular tongue may by a similar process be taught to speak the principal ancient and modern languages.—HENRY *Thoughts on Education (Scientific Writings*, vol. i, p. 335). (Sm. Inst., 1886.)

1828. LANGUAGE, PROCESS OF CHANGE IN—The organs of speech are differently framed by Nature in different climates and countries; and even in the same countries some men pronounce their words broader, softer, harder, quicker, or slower than others, and some are unable to pronounce this or that letter. These accidents, by example and imitation, bring on a change of vowels and consonants, whence a language becomes unlike what it was at first.—*Preface to Boucher's Dictionary.* (Translated for *Scientific Side-Lights.)*

1829. LANGUAGE, RACE-STRUGGLES FOR EXTENSION OF—*German and Slav Contend for Control of Education.*—The Germans are doing among the Slavs what the French are doing in Syria. Both in Germany and Austria they have societies called German school associations. They establish schools in Bohemia, in Moravia, in Styria, and elsewhere, seeking to attract to them the Slav children by means of gratuities, good organization of the instruction, hygienic management of the buildings, etc. The expenses of these schools are covered by assessment of the members of the association. Naturally the Slavs resist, and in order to struggle against the Germans they also found societies of the same kind to maintain Slav schools. In this struggle evidently the school that is most perfect will triumph in the long run. And this will displace the linguistic frontier to the profit of the nation that is most energetic. Aside from the schools, societies of all kinds are being formed for the propaganda of a language, such, for example, as the *Alliance française*, which has been in existence since 1883.—NOVICOW *Les Luttes entre Sociétés humaines*, p. 101. (Translated for *Scientific Side-Lights.)*

1830. LANGUAGE, THE EVOLUTION OF—*Archbishop Trench—How Language is Divine—God Gave, Not Names, but a Power of Naming (Gen. ii, 19-20)—Man Not a Parrot.*—Even Trench at this point succumbs to the theory of development, and his testimony is the more valuable that it is evidently so very much against the grain to admit it. He begins by stating apparently the opposite: "The truer answer to the inquiry how language arose is this: God gave man language just as he gave him reason, and just because he gave him reason; for what is man's *word* but his *reason* coming forth that it may behold itself? They are indeed so essentially one and the same that the Greek language has one word for them both. He gave it to him because he could not be man—that is, a social being—without it." Yet he is too profound a student of words to fail to qualify this. . . . "Yet," he continues, "this must not be taken to affirm that man started at the first furnished with a full-formed vocabulary of words, and, as it were, with his first dictionary and first grammar ready made to his hands. He did not thus begin the world with *names*, but *with the power of naming:* for man is not a mere speaking machine; God did not teach him words, as one of us teaches a parrot, from without, but gave him a capacity, and then evoked the capacity which he gave" [Trench, "The Study of Words," pp. 14-15].—DRUMMOND *Ascent of Man*, ch. 5, p. 177. (J. P., 1900.)

1831. LANGUAGE THE NATURAL STUDY OF CHILDHOOD—*Science Requires Maturity of Mind.*—The study of language should be prosecuted in childhood, as it is, in fact, in the acquisition of the mother-tongue. . . . The memory for words should be exercised and stimulated. Choice tales, poems (narrative and lyric) should be learned for recitation. Natural history in all its branches, as contrasted with the sciences of Nature or scientific physics, should be mastered with the objects before the eye—flowers, minerals, shells, birds, and beasts. These studies should all be mastered in the springtime of life, when the tastes are simple, the heart is fresh, and the eye is sharp and clear. The facts of history and geography should be fixed by repetition and stored away in order. But science of every kind—whether of language, of Nature, of the soul, or of God—as science, should not be prematurely taught. For the consequence is either disgust and hostility to all study, on the one hand, or, on the other, superficial thinking, presumptuous conceit, and, worst of all, sated curiosity. The law of intellectual progress involves effort and discipline severely imposed and constantly maintained, but the effort and discipline should follow the guidance of Nature.—PORTER *Human Intellect*, § 61, p. 74. (S., 1893.)

1832. LANGUAGE, THE SCIENCE OF, UNITES THE AGES—*Value of Philology.*—Philology recognized its calling to be mediator between the remotest ages, to afford us the enjoyment of preserving through thousands of years an unbroken identity with the noblest and greatest nations of the world, by familiarizing us through the medium of grammar and history with the works of their minds and the course of their

destinies, as if there were no gulf to divide us from them.—NIEBUHR *Römische Geschichte*, preface. (Translated for *Scientific Side-Lights.)*

1833. LANGUAGE UNFOLDED FROM DEPTHS OF THOUGHT — Languages, as intellectual creations of man, and as closely interwoven with the development of mind, are, independently of the national form which they exhibit, of the greatest importance in the recognition of similarities or differences in races. This importance is especially owing to the clew which a community of descent affords in threading that mysterious labyrinth in which the connection of physical powers and intellectual forces manifests itself in a thousand different forms. . . . Language is a part and parcel of the history of the development of mind; and however happily the human intellect, under the most dissimilar physical conditions, may unfettered pursue a self-chosen track, and strive to free itself from the dominion of terrestrial influences, this emancipation is never perfect. There ever remains, in the natural capacities of the mind, a trace of something that has been derived from the influences of race or of climate, whether they be associated with a land gladdened by cloudless azure skies or with the vapory atmosphere of an insular region. As, therefore, richness and grace of language are unfolded from the most luxuriant depths of thought, we have been unwilling wholly to disregard the bond which so closely links together the physical world with the sphere of intellect and of the feelings by depriving this general picture of Nature of those brighter lights and tints which may be borrowed from considerations, however slightly indicated, of the relations existing between races and languages.—HUMBOLDT *Cosmos*, vol. i, p. 357. (H., 1897.)

1834. LANGUAGE, VALUE OF THE STUDY OF—*Versatility and Flexibility of Mind—The End To Be Aimed at in Secondary Instruction.*—All experts agree that the preparatory training of students of the gymnasium is superior to that of those who graduate from any other institution of learning, because it produces greater facility in the faculty of thinking, furnishing more power in finding one's way in the domain of the various new disciplines that are taken up. If that is true—and the fact cannot be denied—the reason for it can only be traced to the language-instruction which is the thing that distinguishes the plan of instruction in the gymnasium from the other secondary schools. And, in fact, instruction in language can be designated a most eminent means of training. . . . By means of it the student attains a certain versatility and flexibility of mind that enable him always to find his way in those forms of thought best corresponding to the specific departments of knowledge or to the fields of research.—KLEINWÄCHTER *Zur Frage des naturwissenschaftlichen Unterrichts (Deutsche Zeit- und Streit-Fragen*, p. 246). (Translated for *Scientific Side-Lights.)*

1835. LANGUAGE WOMAN'S SPECIALTY—*Source of Man's Taciturnity.*—The Mexicans say, "A woman is the best dictionary." This unpremeditated confession is based upon an early induction made by the aborigines of that country centuries ago. Savage men, in hunting and fishing, are much alone, and have to be quiet, hence their taciturnity; but women are together, and chatter all day long. Away from the centers of culture women are still the best dictionaries, talkers, and letter-writers.—MASON *Woman's Share in Primitive Culture*, ch. 9, p. 190. (A., 1894.)

1836. LAVA, CAVERNS IN—*Subterranean Grottoes and Vaults of Etna.*—Mention was made of the entrance of a lava-stream into a subterranean grotto, whereby the foundations of a hill were partially undermined. Such underground passages are among the most curious features on Ætna, and appear to have been produced by the hardening of the lava during the escape of great volumes of elastic fluids, which are often discharged for many days in succession after the crisis of the eruption is over. Near Nicolosi, not far from Monti Rossi, one of these great openings may be seen, called the Fossa della Palomba, 625 feet in circumference at its mouth, and seventy-eight deep. After reaching the bottom of this we enter another dark cavity, and then others in succession, sometimes descending precipices by means of ladders. At length the vaults terminate in a great gallery ninety feet long and from fifteen to fifty broad, beyond which there is still a passage never yet explored, so that the extent of these caverns remains unknown. The walls and roofs of these great vaults are composed of rough and bristling scoriæ of the most fantastic forms. —LYELL *Principles of Geology*, bk. ii, ch. 25, p. 401. (A., 1854.)

1837. LAW AS AN OBSERVED ORDER OF FACTS—*Cause of Chemical Phenomena Unknown.*—The first and, so to speak, the lowest sense in which law is applied to natural phenomena is that in which it is used to express simply "an observed order of facts"—that is to say, facts which under the same conditions always follow each other in the same order. In this sense the laws of Nature are simply those facts of Nature which recur according to a rule. It is not necessary to the legitimate application of law in this sense that the cause of any observed order of facts should be at all known or even guessed at. The force or forces to which that order is due may be hid in total darkness. . . . A very large proportion of the laws of every science are laws of this kind and in this sense. For example, in chemistry the behavior of different substances towards each other, in re-

spect to combination and affinity, is reduced to system under laws of this kind, and of this kind only. Because, altho there is a probability that electric or galvanic force is the cause or one of the causes of the series of facts exhibited in chemical phenomena, this is as yet no better than a probability, and the laws of chemistry stand no higher than facts which by observation and experiment are found to follow certain rules.—ARGYLL *Reign of Law*, ch. 2, p. 40. (Burt.)

1838. LAW CONSISTENT WITH DESIGN—*Will Adapts Natural Laws to Its Purpose.*—Our own experience shows that the universal reign of law is perfectly consistent with a power of making those laws subservient to design—even when the knowledge of them is but slight, and the power over them slighter still. How much more easy, how much more natural, to conceive that the same universality is compatible with the exercise of that Supreme Will before which all are known and to which all are servants! What difficulty in this view remains in the idea of the Supernatural? Is it any other than the difficulty in believing in the existence of a Supreme Will—in a living God?—ARGYLL *Reign of Law*, ch. 1, p. 13. (Burt.)

1839. LAW DOES NOT NEGLECT THE LEAST—*Gravitation Holds Even Microscopic Germs.*—The influence of gravity upon bacteria in the air may be observed in various ways, in addition to its action within a limited area like a sewer or a room. Miquel found in some investigations in Paris that, whereas on the Rue de Rivoli 750 germs were present in a cubic meter, yet at the summit of the Panthéon only 28 were found in the same quantity of air. At the tops of mountains air is germ-free, and bacteria increase in proportion to descent. As Tyndall has pointed out, even ultramicroscopic cells obey the law of gravitation. This is equally true in the limited areas of a laboratory or warehouse and in the open air.—NEWMAN *Bacteria*, ch. 3, p. 106. (G. P. P., 1899.)

1840. LAW EXALTS PHENOMENA—*The Same Smoke Column Blue and Red.*—Touched by the wand of law, the dross of facts becomes gold, the meanest being raised thereby to brotherhood with the highest. Thus the smoke of an Irish cabin lifts our speculations to the heavenly dome. . . . The selfsame column of smoke may be projected against a bright and a dark portion of the same cloud, and thus made to appear blue and red at the same time. The blue belongs to the light reflected from the smoke; the red to the light transmitted through it. In like manner the hues of the atmosphere are not due to coloring matter, but to the fact of its being a turbid medium. Through this we look at the blackness of unillumined space and see the blue at the western heaven at sunset, and meet that light which steeps the clouds of evening in orange and crimson dyes.—TYNDALL *Hours of Exercise in the Alps (Notes, etc., Killarney)*, p. 420. (A., 1898.)

1841. LAW HOLDS EVEN THE WANDERING COMETS—*They Move Obedient to the Primal Impulse and Gravitation—Comets of Solar System, Perhaps Expelled from Giant Planets.*—Since these comets are associated in so peculiar a manner with the giant planets [Jupiter, Saturn, Uranus, and Neptune] of the solar system, may it not be that they bear a relation to these planets somewhat resembling that which the large comets bear to the suns which people space? As the large comets would seem to have been expelled from these suns, may not the small comets have been expelled from the giant planets? We need not necessarily assume that these giant planets are still in the active and sunlike state necessary, we may suppose, for the expulsion of comets. . . . It may be that the birth of the comet families of the giant planets took place in far distant eras when these orbs were not merely, as now, instinct with an intense heat, but also aglow with light, so as to present, when viewed from other systems, the aspect which the small companions of unequal double stars present to our telescopists.—PROCTOR *Expanse of Heaven*, p. 156. (L. G. & Co., 1897.)

1842. LAW IN LEAF-MOVEMENTS—*Leaves Vertical in Sleeping Plants.*—Leaves, when they go to sleep, move either upwards or downwards, or, in the case of the leaflets of compound leaves, forwards, that is, towards the apex of the leaf, or backwards, that is, towards its base; or, again, they may rotate on their own axes without moving either upwards or downwards. But in almost every case the plane of the blade is so placed as to stand nearly or quite vertically at night. Therefore the apex, or the base, or either lateral edge may be directed towards the zenith. Moreover, the upper surface of each leaf, and more especially of each leaflet, is often brought into close contact with that of the opposite one; and this is sometimes effected by singularly complicated movements. This fact suggests that the upper surface requires more protection than the lower one.—DARWIN *Power of Movement in Plants*, ch. 6, p. 281. (A., 1900.)

1843. LAW INVARIABLE UNDER SAME CONDITIONS—*Variable When Conditions Vary—Purpose Adapted to Changed Relations.*—We hear of rigid and universal sequence—necessary—invariable; of unbroken chains of cause and effect, no link of which can, in the nature of things, be ever broken. And this idea grows upon the mind, until in some confused manner it is held as casting out the idea of purpose in creation, and inconsistent with the element of will. If it be so, the difficulty cannot be evaded by denying the uniformity, any more than the universality, of law. It is perfectly true that every law is in its own nature invari-

able, producing always precisely and necessarily the same effects—that is, provided it is worked under the same conditions. But then, if the conditions are not the same the invariableness of effect gives place to capacities of change which are almost infinite. It is by altering the conditions under which any given law is brought to bear, and by bringing other laws to operate upon the same subject, that our own wills exercise a large and increasing power over the material world. And be it observed—to this end the uniformity of laws is no impediment, but, on the contrary, it is an indispensable condition. Laws are in themselves—if not unchangeable—at least unchanging, and if they were not unchanging they could not be used as the instruments of will. If they were less rigorous they would be less certain, and the least uncertainty would render them incapable of any service. No adjustment, however nice, could secure its purpose if the implements employed were of uncertain temper.

The notion, therefore, that the uniformity or invariableness of the laws of Nature cannot be reconciled with their subordination to the exercise of will, is a notion contrary to our own experience.—ARGYLL *Reign of Law*, ch. 2, p. 58. (Burt.)

1844. LAW OF CONSTANCY OR CONTINUITY—*Exemplified by Action of the Voltaic Battery—Effect Exerted at a Distance from the Cause.*—Before you is an instrument—a small voltaic battery—in which zinc is immersed in a suitable liquid. An attractive force is at this moment exerted between the metal and the oxygen of the liquid, actual union, however, being in the first instance avoided. Uniting the two ends of the battery by a thick wire, the attraction is satisfied, the oxygen unites with the metal, zinc is consumed, and heat, as usual, is the result of the combustion. A power which, for want of a better name, we call an electric current, passes at the same time through the wire. Cutting the thick wire in two, let the severed ends be united by a thin one. It glows with a white heat. . . . Suppose in the first instance, when the thick wire is employed, that we permit the action to continue until 100 grains of zinc are consumed, the amount of heat generated in the battery would be capable of accurate numerical expression. Let the action then continue, with the thin wire glowing, until 100 grains of zinc are consumed. . . . The amount of heat generated in the battery . . . will be less by the precise amount generated in the thin wire outside the battery. In fact, by adding the internal heat to the external, we obtain for the combustion of 100 grains of zinc a total which never varies. We have here a beautiful example of that law of constancy as regards natural energies, the establishment of which is the greatest achievement of modern scientific philosophy. By this arrangement, then, we are able to burn our zinc at one place, and to exhibit the effects of its combustion at a distance. In New York, for example, we may have our grate and fuel; but the heat and light of our fire may be made to appear at San Francisco.—TYNDALL *Lectures on Light*, lect. 1, p. 6. (A., 1898.)

1845. ——— ——— *Suddenness in Nature—Lightning—Chemical Combination.*—The same ultimate conceptions, and no other, appear to constitute all the truth that is to be found in a favorite doctrine among the cultivators of physical science—the so-called "Law of Continuity." This phrase is indeed often used with such looseness of meaning that it is extremely difficult to understand the primary signification attached to it. One common definition, or rather one common illustration, of this law is said to be that Nature does nothing suddenly—nothing "*per saltum*" [literally, by a leap]. Of course, this can only be accepted under some metaphorical or transcendental meaning. In Nature there is such a thing as a flash of lightning, and this is generally recognized as sufficiently sudden. . . . The action of chemical affinity is always rapid, and very often even instantaneous. Yet these are among the most common and the most powerful factors in the mechanism of Nature. They have the most intimate connection with the phenomena of life, and we know only too well that in these the profoundest changes are often determined in moments of time. For many purposes to which this so-called "Law of Continuity" is often applied in argument no idler dogma was ever invented in the schools.—ARGYLL *Unity of Nature*, ch. 4, p. 83. (Burt.)

1846. LAW OF DEATH—*Natural Tendencies to Dissolution—Life a Temporary Resistance of Disorganizing Forces.*—There is in every living organism a law of death. We are wont to imagine that Nature is full of life. In reality it is full of death. One cannot say it is natural for a plant to live. Examine its nature fully, and you have to admit that its natural tendency is to die. It is kept from dying by a mere temporary endowment, which gives it an ephemeral dominion over the elements—gives it power to utilize for a brief span the rain, the sunshine, and the air. Withdraw this temporary endowment for a moment and its true nature is revealed. Instead of overcoming Nature it is overcome. The very things which appeared to minister to its growth and beauty now turn against it and make it decay and die. The sun which warmed it withers it; the air and rain which nourished it rot it. It is the very forces which we associate with life which, when their true nature appears, are discovered to be really the ministers of death.—DRUMMOND *Natural Law in the Spiritual World*, essay 2, p. 92. (H. Al.)

1847. LAW OF GROWTH IN STRUCTURE OF THE EARTH—Formerly men looked upon the earth as a unit in time, as

the result of one creative act, with all its outlines established from the beginning. It has been the work of modern science to show that its inequalities are not contemporaneous or simultaneous, but successive, including a law of growth—that heat and cold, and the consequent expansion and contraction of its crust, have produced wrinkles and folds upon the surface, while constant oscillations, changes of level which are even now going on, have modified its conformation, and molded its general outline through successive ages. — AGASSIZ *Geological Sketches*, ser. i. ch. 4. p. 98. (H. M. & Co., 1896.)

1848. LAW OF MAN TO FOLLOW LAW OF NATURE—*Control by Change of Conditions—A Recent Conception.*—Just as the will of the individual can operate upon itself by the use of means, some of which are known instinctively, whilst others are found out by reason; so can the collective will of society operate upon the conduct of its members in two ways—first, directly by authority; and secondly, indirectly by altering the conditions out of which the most powerful motives spring. This last is a principle of government which has been distinctly recognized only in modern times, and which admits of applications not yet foreseen. The idea of founding human law upon the laws of Nature is an idea which, tho sometimes instinctively acted upon, was never systematically entertained in the ancient world. Indeed, the true conception of natural law is one founded on the progress of physical investigation, and growing out of the habits of scientific thought.—ARGYLL *Reign of Law*, ch. 7, p. 194. (Burt.)

1849. LAW, ORDINARY ACTION OF, REVERSED—*Death by Falling Upwards—Peculiar Peril of Deep-sea Fish.*—The fish that live at these enormous depths are, in consequence of the enormous pressure, liable to a curious form of accident. If, in chasing their prey or for any other reason, they rise to a considerable distance above the floor of the ocean, the gases of their swimming-bladder become considerably expanded and their specific gravity very greatly reduced. Up to a certain limit the muscles of their bodies can counteract the tendency to float upwards and enable the fish to regain its proper sphere of life at the bottom; but beyond that limit the muscles are not strong enough to drive the body downwards, and the fish, becoming more and more distended as it goes, is gradually killed on its long and involuntary journey to the surface of the sea. The deep-sea fish, then, are exposed to a danger that no other animals in this world are subject to, namely that of tumbling upwards.

That such accidents do occasionally occur is evidenced by the fact that some fish, which are now known to be true deep-sea forms, were discovered dead and floating on the surface of the ocean long before our modern investigations were commenced.—HICKSON *Fauna of the Deep Sea*, ch. 2, p. 21. (A., 1894.)

1850. LAW, UNIVERSAL — *Courses of Shooting-stars Obey—Why Not Each Human Life?*—Such is the course of these minute shooting-stars, a course now perfectly determined. A lesson as profound as unexpected, the shooting-star itself does not glide by chance, borne along by an arbitrary wind; it describes a mathematical orbit as well as the earth or the colossal Jupiter. All is ruled, decreed by the supreme Law; and—who knows?—perhaps each of our frail existences, each of our ephemeral actions, is also determined by the invisible Nature which places the star in the sky, the infant in the cradle, the old man in the tomb.—FLAMMARION *Popular Astronomy*, bk. v, ch. 4. p. 541. (A.)

1851. ——— ——— *Holds Every Particle of Matter—The Lost Comet—Every Fragment Would Follow Path of Total Mass.*—Since the comet [Biela's] was last seen it has thrice traversed the enormous orbit here described, passing from a least distance of about eighty millions of miles to its greatest distance, amounting nearly to six hundred millions of miles. Whether it has been destroyed as a comet, or whether it has only been so far dissipated as to be invisible in our most powerful telescopes, we do not know. But in either case it has pursued the same general course, for the minutest fragment of its substance would obey as implicitly the law of gravity as the once complete comet, or even as the staider members of the solar family—the planets.—PROCTOR *Expanse of Heaven*, p. 132. (L. G. & Co., 1897.)

1852. LAWS, DESIGN TRANSFERRED FROM PHENOMENA TO—The question now before us—whether the evidences of intelligent design, which theology has hitherto recognized in the structure of organized beings, are or are not any longer tenable, when viewed under the new light thrown upon them by the Darwinian lamp—is one which, tho science has much to say upon it, it is beyond the province of science to decide. Newton and Laplace were both accused of atheism by their contemporaries for setting up their own conceptions in the place of the action of the Creator; and you well know that the same charge has been brought against Darwin. I shall endeavor to show you that in his case, as in that of his great predecessors, the real result of his scientific work has been to effect for biology what they are well said by Dr. Whewell to have effected for astronomy—the "transfer of the notion of design and end from the region of facts to that of laws."—CARPENTER *Nature and Man*, lect. 15, p. 413. (A., 1889.)

1853. LAWS, INDUSTRIAL AND MORAL—*In All Industries Man Is Still Man.*—We do not regard the industrial life as

isolated, nor as the isolated result of specifically economic forces having natural laws peculiar to itself. The industrial life is a free product of the human spirit; the total industrial activity of a people is only one side of the national life standing in the closest causal relations with the other phenomena of the national spirit; the industrial forces are general forces working in man and in Nature, which are only producing particular forms, and in these forms particular effects. Above all things we emphasize that our dealings are with persons, with people who, being active in the family, the state, and society, are also active industrially; but with people who are not something else in this department than they are elsewhere. And for that reason we do not recognize any motives that are peculiarly industrial, and cannot admit that industrial life is a domain to which the general moral teachings and the categorical imperative of moral duty do not apply. On the contrary we affirm that the moral law and devotion to moral duty must become the determining force here also as well as in the remainder of the national life, if society is to develop prosperous conditions.

Our so-called laws are historic and relative, our solutions are relative, only possible of execution by means of exact information, of consideration of the actual concrete circumstances.—SCHÖNBERG *Die Volkswirthschaftslehre (Sammlung wissenschaftlicher Vorträge, Serie viii)*. (Translated for *Scientific Side-Lights.)*

1854. LAWS OF HISTORY LIKE THOSE OF SCIENCE—*Merely Statements of Cause and Effect.*—It is folly, then, to speak of the "laws of history" as of something inevitable, which science has only to discover, and whose consequences any one can then foretell, but do nothing to alter or avert. Why, the very laws of physics are conditional and deal with *ifs*. The physicist does not say, "The water will boil, anyhow"; he only says it will boil if a fire be kindled beneath it. And so the utmost the student of sociology can ever predict is that *if* a genius of a certain sort show the way, society will be sure to follow.—JAMES *Essays in Popular Philosophy*, p. 244. (L. G. & Co., 1899.)

1855. LAWS OF NATURE — *Contrasted with Laws of Man—A Deadlock Results in Public Misfortune.*—The laws of man are also laws of Nature when founded on a true perception of natural tendencies and a just appreciation of combined results. On the other hand, human laws are at variance with or antagonistic to the laws of Nature when founded either on the desire of attaining a wrong end, or on the attempt to reach a right end by mistaken means. In either of these cases positive institution and natural law become opposed, and thus a bad contrivance in legislation, like a bad contrivance in mechanics, comes always to some deadlock at last. Time and natural consequence are great teachers in politics as in other things. Our sins and our ignorances find us out. Both in conduct and in opinion natural law is ever working to convict error, to reveal and to confirm the truth.—ARGYLL *Reign of Law*, ch. 7, p. 212. (Burt.)

1856. ——— ——— *Never Subverted by Human Agency—Moral Ends Proposed in Life of Man.*—If, then, an intelligent being, after observing the order of events for an indefinite series of ages, had witnessed at last so wonderful an innovation as this [the introduction of man upon the planet], to what extent would his belief in the regularity of the system be weakened? Would he cease to assume that there was permanency in the laws of Nature? Would he no longer be guided in his speculations by the strictest rules of induction? To these questions it may be answered that had he previously presumed to dogmatize respecting the absolute uniformity of the order of Nature he would undoubtedly be checked by witnessing this new and unexpected event, and would form a more just estimate of the limited range of his own knowledge and the unbounded extent of the scheme of the universe. But he would soon perceive that no one of the fixed and constant laws of the animate or inanimate world was subverted by human agency, and that the modifications now introduced for the first time were the accompaniments of new and extraordinary circumstances, and those not of a physical but of a moral nature. The deviation permitted would also appear to be as slight as was consistent with the accomplishment of the new moral ends proposed, and to be in a great degree temporary in its nature, so that whenever the power of the new agent was withheld, even for a brief period, a relapse would take place to the ancient state of things: the domesticated animal, for example, recovering in a few generations its wild instinct, and the garden-flower and fruit-tree reverting to the likeness of the parent stock.—LYELL *Principles of Geology*, bk. i. ch. 9, p. 152. (A., 1854.)

1857. ——— ——— *Not Agents—Human Generalizations from Phenomena—Origin of Force Unknown.*—The laws of Nature are merely mental generalizations of our own, and so far as they go show a remarkable harmony between our mental nature and that manifested in the universe. They are not themselves powers capable of producing effects, but merely express what we can ascertain of uniformity of action in Nature. The law of gravitation, for example, gives no clue to the origin of that force, but merely expresses its constant mode of action in whatever way that may have been determined at first. Nor are natural laws decrees of necessity. They might have been otherwise—nay, many of them may be otherwise in parts of the uni-

verse inaccessible to us, or they may change in process of time; for the period over which our knowledge extends may be to the plans of the Creator like the lifetime of some minute insect which might imagine human arrangements of no great permanence to be of eternal duration.—DAWSON *Facts and Fancies in Modern Science,* lect. 1, p. 39. (A. B. P. S.)

1858. ——— ——— *Not Matters of Experience—Faith Demanded by Scientific Doctrines.*—The most persistent outer relations which science believes in are never matters of experience at all, but have to be disengaged from under experience by a process of elimination—that is, by ignoring conditions which are always present. The *elementary* laws of mechanics, physics, and chemistry are all of this sort. The principle of uniformity in Nature is of this sort; it has to be *sought* under and in spite of the most rebellious appearances; and our conviction of its truth is far more like a religious faith than like assent to a demonstration.—JAMES *Psychology,* vol. ii, ch. 28, p. 636. (H. H. & Co., 1899.)

1859. ——— ——— *The Methods of God—Science Does Not Reach Causes.*—In the use of this word *law,* as applied to Nature, we are often grossly misunderstood. Says a recent writer, somewhat contemptuously, "The philosopher knows no better the cause of the law of gravitation than the ignorant man." The author, in his simplicity, is unaware that laws, not causes, are the end of true philosophy. We seek to study out the method of God's doings in Nature, and enunciations of this his method or will are what is meant by the "laws of Nature." If those who look coldly on science knew better its aims, we should hear less of the infidelity of the term *law,* and find fewer infidels or rejecters of that revelation which God has spread before us.

We know that this is not the only revelation; that another tells man of his duties and responsibilities, of the celestial sympathy which surrounds him and his immortal destiny—subjects far beyond the teachings of physical or brute nature. The one is but the complement of the other; the two harmonious in their truths, as in their exalted origin.—DANA *Proceedings of the American Association for the Advancement of Science, 1855,* vol. ix, p. 1.

1860. ——— ——— *The Thoughts of God.*—Let me not be understood to imply a belief that man cannot attain to any absolute scientific truth; for I believe that he can, and I feel that every great generalization brings him a step nearer to the promised goal. Moreover, I sympathize with that beautiful idea of Oersted which he expressed in the now familiar phrase, "*The laws of Nature are the thoughts of God*"; but then I also know that our knowledge of these laws is as yet very imperfect, and that our human systems must be at the best but very partial expressions of the truth. Still, it is a fact worthy of our profound attention that in each of the physical sciences, as in astronomy, the successive great generalizations which have marked its progress have included and expanded rather than superseded those which went before them. Through the great revolutions which have taken place in the forms of thought the elements of truth in the successive systems have been preserved, while the error has been as constantly eliminated; and so, as I believe, it always will be, until the last generalization of all brings us into the presence of that law which is indeed the thought of God.—COOKE *The New Chemistry,* lect. 1, p. 2. (A., 1899.)

1861. ——— ——— *Used in Works of Nature as in Works of Man—Structure Adapted to Their Demands—Design in Structure of Barnacles.*—Now, the laws of Nature appear to be employed in the system of Nature in a manner precisely analogous to that in which we ourselves employ them. The difficulties and obstructions which are presented by one law in the way of accomplishing a given purpose are met and overcome exactly on the same principle on which they are met and overcome by man, viz., by knowledge of other laws and by resource in applying them—that is, by ingenuity in mechanical contrivance. It cannot be too much insisted on that this is a conclusion of pure science. The relation which an organic structure bears to its purpose in Nature can be recognized as certainly as the same relation between a machine and its purpose in human art. It is absurd to maintain, for example, that the purpose of the cellular arrangement of material in combining lightness with strength is a purpose legitimately cognizable by science in the Menai Bridge, but is not as legitimately cognizable when it is seen in Nature, actually serving the same use. The little barnacles which crust the rocks at low tide, and which to live there at all must be able to resist the surf, have the building of their shells constructed strictly with reference to this necessity. It is a structure all hollowed and chambered on the plan which engineers have so lately discovered as an arrangement of material by which the power of resisting strain or pressure is multiplied in an extraordinary degree. That shell is as pure a bit of mechanics as the bridge, both being structures in which the same arrangement is adapted to the same end.—ARGYLL *Reign of Law,* ch. 2, p. 59. (Burt.)

1862. LAWS, ORDINARY, SUPERSEDED—*The Preservation of the Jews—Result Yet Reached by the Use of Means.*—The preservation of the Jews as a distinct people during so many centuries of complete dispersion is a fact standing nearly, if not absolutely, alone in the history of the world. It is at variance with all other experience of the laws which govern the amalgamation

with each other of different families of the human race. . . . It is not surprising, therefore, that the preservation of the Jews, partly from the relation in which it stands to the apparent fulfilment of prophecy, and partly from the extraordinary nature of the fact itself, is tacitly assumed by many persons to come strictly within the category of miraculous events. Yet in itself it is nothing more than a striking illustration how a departure from the "ordinary course of Nature" may be effected through the instrumentality of means which are natural and comprehensible. An extraordinary resisting power has been given to the Jewish people against those dissolving and disintegrating forces which have caused the disappearance of every other race placed under similar conditions. They have been torn from home and country and removed, not in a body, but in scattered fragments over the world. Yet they are as distinct from every other people now as they were in the days of Solomon. Nevertheless this resisting power, wonderful tho it be, is the result of special laws, overruling those in ordinary operation. It has been effected by the use of means. Those means have been superhuman —they have been beyond human contrivance and arrangement. But they belong to the region of the natural. They belong to it not the less, but all the more, because in their concatenation and arrangement they seem to indicate the purpose of a living will seeking and effecting the fulfilment of its designs. This is the manner after which our own living wills in their little sphere effect their little objects. Is it difficult to believe that after the same manner also the divine will, of which ours is the image only, works and effects its purposes?—ARGYLL *Reign of Law*, ch. 1, p. 12. (Burt.)

1863. LEAD-FRONDS GROWING LIKE FERNS AROUND VOLTAIC WIRE—By sending a voltaic current through a liquid you know that we decompose the liquid, and if it contains a metal we liberate this metal by the electrolysis. . . . Into the cell [containing a solution of acetate of lead] are dipped two very thin platinum wires, and these are connected by other wires with a small voltaic battery. On sending the voltaic current through the solution the lead will be slowly severed from the atoms with which it is now combined; it will be liberated upon one of the wires, and at the moment of its liberation it will obey the polar forces of its atoms and produce crystalline forms of exquisite beauty, . . . sprouting like ferns from the wire, appearing, indeed, like vegetable growths rendered so rapid as to be plainly visible to the naked eye. On reversing the current these wonderful lead-fronds will dissolve, while from the other wire filaments of lead dart through the liquid. In a moment or two the growth of the lead-trees recommences, but they now cover the other wire.—TYNDALL *Lectures on Light*, lect. 3, p. 105. (A., 1898.)

1864. LEAF-TRACERY IN THE ANCIENT ROCKS—*Enduring Record of the Evanescent.*—The earth had already its seasons, its spring and summer, its autumn and winter, its seed-time and harvest, tho neither sower nor reaper was there; the forests then, as now, dropped their thick carpet of leaves upon the ground in the autumn, and in many localities they remain where they originally fell, with a layer of soil between the successive layers of leaves—a leafy chronology, as it were, by which we read the passage of the years which divided these deposits from each other. Where the leaves have fallen singly on a clayey soil favorable for receiving such impressions they have daguerreotyped themselves with the most wonderful accuracy, and the oaks, poplars, willows, maples, walnuts, gum- and cinnamon-trees, etc., of the Tertiaries are as well known to us as are those of our own time.—AGASSIZ *Geological Sketches*, ser. i, ch. 7, p. 182. (H. M. & Co., 1896.)

1865. LEAPS OF NATURAL PROCESSES—*The Metamorphoses of Insects.*—When we think of the mystery involved in the metamorphoses of insects and in the corresponding phenomena of alternate generation in other classes of the animal kingdom, we must see what unlimited possibilities of creation lie open in methods which are in full operation round us. In the higher animals the development of germs is carried on in vital and physical connection with the perfected organism of the mother, and the cycle of changes which lead up to the completion of the parent form is a cycle which thus appears to be wholly governed by the surrounding medium. But when we look at the metamorphoses of insects no such delusion is possible. A creature which to all appearance is fully formed, and which has led a separate and independent existence, suddenly lays itself to sleep. In that condition, without any food—without any contact with any directing physical agency external to itself—its organization is wholly altered, its whole body is rearranged, its old members dissolve and disappear, new members emerge, and in a few days or weeks are perfected in form and in power. Moreover, that form and that power are both for uses which, so far as the creature's previous "experience" is concerned, are absolutely new. With such "leaps" as this in the creative work going on in every field and stream and sea around us, we may have the utmost confidence that the same work has involved the same principles through all time.—ARGYLL *Unity of Nature*, ch. 7, p. 161. (Burt.)

1866. LEARNING, NO ROYAL ROAD TO—*Archimedes Instructing the King.*—One day the Tyrant of Syracuse ordered the illustrious Archimedes to omit the principal mathematics in a lesson on astronomy which prom-

ised well, but commenced a little severely. "Let us proceed," replied Archimedes, without modifying his professorial tone—"let us proceed: there is here no privileged road for kings." In astronomy there is no privileged road for any one, and if we wish to gain information it is indispensable that we should first understand the principles of geometrical measurements.—FLAMMARION *Popular Astronomy,* bk. ii, ch. 1, p. 85. (A.)

1867. LEARNING THE WAY NECESSARY FOR BEES—*Sense of Direction Not a Blind Instinct.*—Sir John Lubbock [Lord Avebury] observes: "I never found bees to return if brought any considerable distance at once. By taking them, however, some twenty yards each time they came to the honey I at length *trained* them to come to my room"; that is to say, bees require to *learn* their way little by little before they can return to a store of honey which they may have been fortunate enough to find; their general sense of direction is not in itself a sufficient guide. This, at least, is the case where, as in the experiments in question, the bees are *carried* from the hive to the store of honey (here a distance of less than 200 yards); possibly if they had found the honey by themselves flying towards it, and so probably taking note of objects by the way, one journey might have proved sufficient to teach them the way. But whether or not this would have been the case, the fact that when carried they required also to be taught the way piece by piece is conclusive proof that their sense of direction *alone* is not sufficient to enable them to traverse a route of 200 yards a second time.—ROMANES *Animal Intelligence,* ch. 4, p. 145. (A., 1899.)

1868. LEAVEN AN INVENTION OF WOMAN—"If there be any one discovery owing to chance it is that of leaven. The world was indebted to the economy of some person or other for this happy discovery, who, in order to save a little dough, mixed it with the new. They would, no doubt, be surprised to find that this old dough, so sour and distasteful itself, rendered the new bread so much lighter, more savory, and easy of digestion. More probably leaven arose in hot countries, in the preference shown for the acid flavor of stale porridge (compare the practise of adding curds to fresh milk in order to turn it sour for immediate consumption), as in the *caffa* or porridge-ball of Guinea, which is considered insipid while fresh."—LANDER, quoted by MASON in *Woman's Share in Primitive Culture,* ch. 2, p. 30. (A., 1894.)

1869. LEAVES ON THE MARCH—*Procession of Sauba or Leaf-cutting Ants—Relays of Workers Supplement Each Other.*—In course of time I had plenty of opportunities of seeing them [the sauba-ants] at work. They mount the tree in multitudes, the individuals being all worker-minors [the workers of smallest size]. Each one places itself on the surface of a leaf and cuts with its sharp scissor-like jaws a nearly semicircular incision on the upper side; it then takes the edge between its jaws and by a sharp jerk detaches the piece. Sometimes they let the leaf drop to the ground, where a little heap accumulates, until carried off by another relay of workers; but generally each marches off with the piece it has operated upon, and as all take the same road to their colony the path they follow becomes in a short time smooth and bare, looking like the impression of a cart-wheel through the herbage. . . . When employed on this work their processions look like a multitude of animated leaves on the march. In some places I found an accumulation of such leaves, all circular pieces, about the size of a sixpence, lying on the pathway unattended by ants, and at some distance from any colony. Such heaps are always found to be removed when the place is revisited the next day.—BATES *Naturalist on the River Amazon,* ch. 1, p. 627. (Hum., 1880.)

1870. LIFE, ABUNDANCE OF, IN GEOLOGIC TIMES—*Fossil Fishes Numerous and Diversified.*—The fossil fishes which have been found, and which I have had an opportunity of examining in certain circumscribed regions, form a very favorable basis for comparison and estimate. At Mount Vulcan, near Verona, is a celebrated quarry, not many miles in extent, from which alone have been taken over one hundred different kinds of fossil fishes. The Adriatic in its whole extent does not furnish as many different species as are found in this quarry. I have examined the fossil fishes of the neighborhood of Riga on the Baltic, and they are more numerous than the present living species of the Baltic and German Ocean. Here, then, we have direct evidence that in former periods, within similar areas, there was as great a diversity of animals as now exists.—AGASSIZ *Structure of Animal Life,* lect. 5, p. 94. (S., 1883.)

1871. ——— ——— *Fossils in Silurian Deposits—The Ancient Earth Everywhere Teemed with Life.*—Altho the early geological periods are more legible in North America, because they are exposed over such extensive tracts of land, yet they have been studied in many other parts of the globe. In Norway, in Germany, in France, in Russia, in Siberia, in Kamchatka, in parts of South America, in short, wherever the civilization of the white race has extended, Silurian deposits have been observed, and everywhere they bear the same testimony to a profuse and varied creation. The earth was teeming then with life as now, and in whatever corner of its surface the geologist finds the old strata, they hold a dead fauna as numerous as that which lives and moves above it. Nor do we find that there was any gradual increase or decrease of any organic

forms at the beginning and close of the successive periods. On the contrary, the opening scenes of every chapter in the world's history have been crowded with life, and its last leaves as full and varied as its first.—AGASSIZ *Geological Sketches*, ser. i, ch. 2, p. 60. (H. M. & Co., 1896.)

1872. LIFE, ADVANCED, FRUITFULNESS OF—*Haydn's Success at Sixty—Diligence Rivaling Genius.*—Comfortably settled in the palace of Eisenstadt, in Hungary [as Maestro di Capella to Prince Esterhazy], enjoying in moderation his favorite diversions of hunting and fishing, and relieved from care for the future, Haydn there composed the long series of works in various styles which he produced before his visit to London at nearly sixty years of age; which visit was the immediate occasion of his bringing out his "Twelve Grand Symphonies," and indirectly (by the impression which his hearing of Handel's music made upon him) prompted the composition of the "Creation," which he produced in his sixty-fifth year. During the whole period of his residence with Prince Esterhazy, he may be said to have been educating himself, under peculiar advantages, for those great works of his advanced life on which his reputation now chiefly rests. He had a full and choice band living under the same roof with him, at his command every hour in the day; he had only to order, and they were ready to try the effect of any piece, or even of any passage which, quietly seated in his study, he might commit to paper. Thus at leisure he heard, corrected, and refined whatever he conceived, and never sent forth his compositions until they were in a state to fearlessly challenge criticism.

There can be no question of Haydn's inferiority to Mozart in creative power; but the steadiness of his application to his art, and the advantage he possessed in being constantly able to test his productions by actual trial, enabled him ultimately to attain a place among the first of modern musicians, which Mozart had reached at a bound.—CARPENTER *Mental Physiology*, ch. 6, p. 277. (A., 1900.)

1873. LIFE AND DEATH DEPEND ON NUMBER OF ATOMS—*Elements of Theine and Strychnin Identical.*—The same elements combined in one proportion are sometimes a nutritious food or a grateful stimulant, soothing and sustaining the powers of life; whilst, combined in another proportion, they may be a deadly poison, paralyzing the heart and carrying agony along every nerve and fiber of the animal frame. This is no mere theoretical possibility. It is actually the relation, for example, in which two well-known substances stand to each other—tea and strychnin. The active principles of these two substances, "theine" and "strychnin," are identical so far as their elements are concerned, and differ from each other only in the proportions in which they are combined. Such is the power of numbers in the laboratory of Nature! What havoc in this world, so full of life, would be made by blind chance gambling with such powers as these! What confusion, unless they were governed by laws whose certainty makes them capable of fine adjustment, and therefore subject to accurate control!—ARGYLL *Reign of Law*, ch. 2, p. 57. (Burt.)

1874. LIFE AND DEATH OF PLANTS DEPENDENT ON THEIR "SLEEP"—*Complicated Movements to Avoid Radiation—How the Object Is Secured.*—From the several cases above given [in the record of experiments where leaves were prevented from turning, and died in consequence], there can be no doubt that the position of the leaves at night affects their temperature through radiation to such a degree that when exposed to a clear sky during a frost, it is a question of life and death. We may therefore admit as highly probable, seeing that their nocturnal position is so well adapted to lessen radiation, that the object gained by their often complicated sleep movements, is to lessen the degree to which they are chilled at night. It should be kept in mind that it is especially the upper surface which is thus protected, as it is never directed towards the zenith, and is often brought into close contact with the upper surface of an opposite leaf or leaflet.—DARWIN *Power of Movement in Plants*, ch. 6, p. 297. (A., 1900.)

1875. LIFE A WARFARE—*Body and Mind Must Contend or Be Crushed—Trials Strengthen the Strong, Destroy the Weak.*—Life is surrounded by forces that are always tending to destroy it, and with which it may be represented as in a continued warfare: so long as it contends successfully with them, winning from them and constraining them to further its development, it flourishes; but when it can no longer strive, when they succeed in winning from it and increasing at its expense, it begins to decay and die. So it is with mind in the circumstances of its existence: the individual who cannot use circumstances, or accommodate himself successfully to them, and in the one way or the other make them further his development, is controlled and used by them: being weak, he must be miserable, must be a victim; and one way in which his suffering and failure will be manifest will be in insanity. Thus it is that mental trials which serve in the end to strengthen a strong nature break down a weak one which cannot fitly react, and that the efficiency of a moral cause of insanity betrays a conspiracy from within with the unfavorable outward circumstances.—MAUDSLEY *Body and Mind*, lect. 3, p. 93. (A., 1898.)

1876. LIFE COMPARED TO THE COMMANDER OF AN ARMY—*An Unseen Controlling Influence—Power in Skilled Conformity to Nature's Laws.*—Let us . . . suppose that a war is being carried

on by a vast army, at the head of which there is a very great commander. Now, this commander knows too well to expose his person; in truth, he is never seen by any of his subordinates. He remains at work in a well-guarded room, from which telegraphic wires lead to the headquarters of the various divisions. He can thus, by means of these wires, transmit his orders to the generals of these divisions, and by the same means receive back information as to the condition of each. Thus his headquarters becomes a center into which all information is poured, and out of which all commands are issued. Now, that mysterious thing called life, about the nature of which we know so little, is probably not unlike such a commander. Life is not a bully, who swaggers out into the open universe, upsetting the laws of energy in all directions, but rather a consummate strategist, who, sitting in his secret chamber, before his wires, directs the movements of a great army.—STEWART *Conservation of Energy*, ch. 6, p. 412. (Hum.. 1880.)

1877. LIFE DIFFUSED THROUGHOUT THE ATMOSPHERE—If the unassisted eye shows that life is diffused throughout the whole atmosphere, the microscope reveals yet greater wonders. Wheel-animalcules, *brachioni*, and a host of microscopic insects are lifted by the winds from the evaporating waters below. Motionless and to all appearance dead, they float on the breeze, until the dew bears them back to the nourishing earth. . . . The yellow meteoric sand or mist (dust nebulæ) often observed to fall on the Atlantic near the Cape Verde Islands, and not infrequently borne in an easterly direction as far as Northern Africa, Italy, and Central Europe, consists, according to Ehrenberg's brilliant discovery of agglomerations of silicious-shelled microscopic organisms. . . . Together with these developed creatures, the atmosphere contains countless germs of future formations; eggs of insects, and seeds of plants, which, by means of hairy or feathery crowns, are borne forward on their long autumnal journey. Even the vivifying pollen scattered abroad by the male blossoms is carried by winds and winged insects over sea and land, to the distant and solitary female plant. Thus, wheresoever the naturalist turns his eye, life or the germ of life lies spread before him.—HUMBOLDT *Views of Nature*, p. 211. (Bell, 1896.)

1878. LIFE, ESTIMATED DURATION OF—*Long or Short, According to Succession of Events—Sense of Duration Relative.*—We have every reason to think that creatures may possibly differ enormously in the amounts of duration which they intuitively feel, and in the fineness of the events that may fill it. Von Baer has indulged in some interesting computations of the effect of such differences in changing the aspect of Nature. Suppose we were able, within the length of a second, to note 10,000 events distinctly, instead of barely 10, as now; if our life were then destined to hold the same number of impressions, it might be 1,000 times as short. We should live less than a month, and personally know nothing of the change of seasons. If born in winter, we should believe in summer as we now believe in the heats of the Carboniferous era. The motions of organic beings would be so slow to our senses as to be inferred, not seen. The sun would stand still in the sky, the moon be almost free from change, and so on. But now reverse the hypothesis and suppose a being to get only one 1,000th part of the sensations that we get in a given time, and consequently to live 1,000 times as long. Winters and summers will be to him like quarters of an hour. Mushrooms and the swifter-growing plants will shoot into being so rapidly as to appear instantaneous creations; annual shrubs will rise and fall from the earth like restlessly boiling water-springs; the motions of animals will be as invisible as are to us the movements of bullets and cannon-balls; the sun will scour through the sky like a meteor, leaving a fiery trail behind him.—JAMES *Psychology*, vol. i, ch. 15, p. 639. (H. H. & Co., 1899.)

1879. LIFE, ETERNAL—*Scientific and Christian Definitions of, Compared.*—The exact terms of Mr. Herbert Spencer's definition of eternal life may now be given. And it will be seen that they include essentially the conditions here laid down. "Perfect correspondence would be perfect life. Were there no changes in the environment but such as the organism had adapted changes to meet, and were it never to fail in the efficiency with which it met them, there would be eternal existence and eternal knowledge." Reserving the question as to the possible fulfilment of these conditions, let us turn for a moment to the definition of eternal life laid down by Christ. Let us place it alongside the definition of science, and mark the points of contact. Uninterrupted correspondence with a perfect environment is eternal life according to science. "This is life eternal," said Christ, "that they may know thee, the only true God, and Jesus Christ whom thou has sent." Life eternal is to know God. To know God is to "correspond" with God. To correspond with God is to correspond with a perfect environment. And the organism which attains to this, in the nature of things must live forever. Here is "eternal existence and eternal knowledge."—DRUMMOND *Natural Law in the Spiritual World*, essay 6, p. 193. (H. Al.)

1880. LIFE EVIDENCED BY CHANGE—*Actions of Living Things Tend to Self-preservation.*—We habitually distinguish between a live object and a dead one by observing whether a change which we make in the surrounding conditions, or one which Nature makes in them, is or is not

followed by some perceptible change in the object. By discovering that certain things shrink when touched, or fly away when approached, or start when a noise is made, the child first roughly discriminates between the living and the not-living. . . . Vegetal and animal life are alike primarily recognized by this process. The tree that puts out leaves when the spring brings increase of temperature, the flower which opens and closes with the rising and setting of the sun, the plant that droops when the soil is dry and reerects itself when watered, are considered alive because of these induced changes. . . .

Not only, however, do we look for some response when an external stimulus is applied to a living organism, but we expect a fitness in the response. Dead as well as living things display changes under certain changes of condition: instance, a lump of carbonate of soda that effervesces when dropped into sulfuric acid; a cord that contracts when wetted; a piece of bread that turns brown when held near the fire. But in these cases we do not see a connection between the changes undergone and the preservation of the things that undergo them. . . . In vital changes, however, such relations are manifest. Light being necessary to vegetal life, we see in the action of a plant which, when much shaded, grows towards the unshaded side, an appropriateness which we should not see did it grow otherwise. Evidently the proceedings of a spider which rushes out when its web is gently shaken and stays within when the shaking is violent, conduce better to the obtainment of food and the avoidance of danger than were they reversed. The fact that we feel surprise when, as in the case of a bird fascinated by a snake, the conduct tends towards self-destruction, at once shows how generally we have observed an adaptation of living changes to changes in surrounding circumstances.—SPENCER *Biology*, pt. i, ch. 5, p. 91. (A., 1900.)

1881. LIFE, EXPERIMENTS FOR RESTORATION OF—Have I the right to conclude from these tests that the injection of blood deprived of its fibrin could suffice to support irritability indefinitely and perfectly, that is to say, the local life of a member separated from the body? At the least, this seems very probable, for, I repeat it, there never was any sensible difference in the degree of muscular irritability fifty and some hours from ten minutes after death.—BROWN-SÉQUARD *Recherches experimentales sur les Propriétés physiologiques et les Usages du Sang Rouge et du Sang Noir (Journal de la Physiologie de l'Homme et des Animaux, 1858*, vol. i, p. 367). (Translated for *Scientific Side-Lights.*)

1882. LIFE, FECUNDITY OF LOWER FORMS OF—*Progeny Numberless—Gradual Diminution in Rising toward Higher Mammalia—Care and Love Concentrated.*—When we examine the progeny of the lowest plants we find ourselves among figures so high that no microscope can count them. The *Protococcus nivalis* shows its exuberant reproductive power by reddening the arctic landscape with its offspring in a single night. When we break or shake the puff-ball of the well-known fungus the cloud of progeny darkens the air with a smoke made up of uncountable millions of spores. *Hydatina senta*, one of the *Rotifera*, propagates four times in thirty-four hours, and in twelve days is the parent of sixteen million young. Among fish the number is still very great. The herring and the cod give birth to a million ova, the frog spawns eggs by the thousand, and most of the creatures at and below that level in a like degree. Then comes a gradual change. When we pass on to the reptiles the figures fall into hundreds. On reaching the birds the young are to be counted by tens or units. In the highest of mammals the rule is one. This bringing-down of the numbers is a remarkable circumstance. It means the calling-in of a diffused care, to focus it upon one, and concentrate it into love.—DRUMMOND *Ascent of Man*, ch. 8, p. 273. (J. P., 1900.)

1883. LIFE FIGHTS OFF CORRUPTION—*Bacteria Cannot Thrive on Normal Living Tissues.*—The normal living tissues have an inimical effect upon bacteria. Saprophytic bacteria of various kinds are normally present on exposed surfaces of skin or mucous membrane. Tissues also which are dead or depressed in vitality from injury or previous disease, but which are still in contact with the tissues, afford an excellent nidus for the growth of bacteria. Still these have not the power, unless specific, to thrive in the normal living tissue. It has been definitely shown that the blood-fluids of the body have in their fresh state the germicidal power . . . which prevents bacteria from flourishing in them.—NEWMAN *Bacteria*, ch. 8, p. 267. (G. P. P., 1899.)

1884. LIFE, FORCES OF, DESTROY USELESS ORGANS—*White Cells (Leucocytes) Devour Tadpole's Tail and Gills.*—When the young frog or tadpole attains a certain stage of development, and when it is about to exchange its water-life for the higher land existence, the fishlike tail requires repression and demands extinction as part and parcel of frog-advance. Of old we believed the disappearance of the frog's tail was due to a simple process of atrophy or wasting away. We know better to-day. By close microscopic investigation we are able to see a curious work proceeding in the tadpole's appendage. It swarms with white cells which have migrated into its substance from the blood-vessels. They are there for a purpose, and they work with a will. They are seen in the act of eating and devouring the substance of their possessor. The tadpole in this sense, and through its semi-independent white-blood cells, is living upon

itself, and eating up life's "principal" in place of living upon the interest represented by its food. Within the bodies of these white cells in the tadpole's tail microscopists have been enabled actually to see the fragments of muscle and nerve they have torn from the tail substance. Little wonder that the tail "grows small by degrees and beautifully less" under such a vigorous attack; and in the gills of the tadpole (which disappear with the tail) the same devouring process is seen to proceed. Thus the disappearance of the tail is a matter of vital action—as much so, indeed, in one sense, as its growth. It is a new experience of life to find certain of the living particles of the body set apart, as in the case of the frog, for the work of ridding that body of its encumbrance, and of assisting it to rise in the scale of life.—WILSON *Glimpses of Nature*, ch. 23, p. 76. (Hum., 1892.)

1885. LIFE FOR OTHERS—*A Natural Law.*—They who perceive that all the nature of living things is primarily for the good of others . . . can no longer wonder if something in our own nature should impel us to acts which are not to our personal liking or advantage; nor need they fear lest the discovery of the natural history of the moral sense may destroy its value. Should it not rather "seem to follow that reasonable creatures were, as the philosophical emperor observes, made one for another; and consequently that man ought not to consider himself as an independent individual, whose happiness is not connected with that of other men; but rather as a part of a whole, to the common good of which he ought to conspire, and order his ways and actions suitably, if he would live according to nature"? [Berkeley, "Alciphron," i, 16].—BROOKS *Foundations of Zoology*, lect. 5, p. 119.

1886. LIFE, FUTURE POSSIBILITIES INVOLVED IN—*Difference between Crystal and Shell.*—The difference on the score of beauty between the crystal and the shell, let us say once more, is imperceptible. But fix attention for a moment, not upon their appearance, but upon their possibilities, upon their relation to the future, and upon their place in evolution. The crystal has reached its ultimate stage of development. It can never be more beautiful than it is now. Take it to pieces and give it the opportunity to beautify itself afresh, and it will just do the same thing over again. It will form itself into a six-sided pyramid, and go on repeating this same form *ad infinitum* as often as it is dissolved, and without ever improving by a hair's breadth. Its law of crystallization allows it to reach this limit, and nothing else within its kingdom can do any more for it. In dealing with the crystal, in short, we are dealing with the maximum beauty of the inorganic world. But in dealing with the shell we are not dealing with the maximum achievement of the organic world. In itself it is one of the humblest forms of the invertebrate sub-kingdom of the organic world; and there are other forms within this kingdom so different from the shell in a hundred respects that to mistake them would simply be impossible.—DRUMMOND *Natural Law in the Spiritual World*, essay 11, p. 345. (H. Al.)

1887. LIFE, HIGHER, MENACED BY LOWER—*Garden Plants Destroyed by Bacteria.*—Reference has been made to the associated work of higher vegetable life and bacteria. The converse is also true. Just as we have bacterial diseases affecting man and animals, so also plant-life has its bacterial diseases. . . . Hyacinth disease is due to a flagellated bacillus. The wilt of cucumbers and pumpkins is a common disease in some districts of the world, and may cause wide-spread injury. It is caused by a white microbe which fills the water-ducts. Wilting vines are full of the same sticky germs. Desiccation and sunlight have a strongly prejudicial effect upon these organisms. Bacterial brown-rot of potatoes and tomatoes is another plant-disease probably due to a bacillus. The bacillus passes down the interior of the stem into the tubers, and brown-rots them from within. There is another form of brown-rot which affects cabbages. It blackens the veins of the leaves, and a woody ring which is formed in the stem causes the leaves to fall off. This also is due to a micro-organism which gains entrance through the water-pores of the leaf, and subsequently passes into the vessels of the plants.—NEWMAN *Bacteria*, ch. 1, p. 35. (G. P. P., 1899.)

1888. LIFE, HUMAN, WHOLESALE DESTRUCTION OF—*Earthquake Followed by Pestilence.*—In this [Calabrian] earthquake 40,000 persons are supposed to have perished, and about 20,000 by the epidemics which followed. Dolomieu gives a painful account of the appearance of the Calabrian cities. "When I passed over to Calabria," he writes, "and first beheld Polistina, the scene of horror almost deprived me of my faculties; my mind was filled with mingled horror and compassion; nothing had escaped; all was leveled with the dust; not a single house or piece of wall remained; on all sides were heaps of stone so destitute of form that they afforded no idea of there having ever been a town on this spot. The stench of the dead bodies still arose from the ruins. I conversed with many persons who had been buried for three, four, or even five days; I questioned them respecting their sensations in so dreadful a situation, and they agreed that of all the physical evils they endured thirst was the most intolerable; and that their mental agony was increased by the idea that they were abandoned by their friends, who might have rendered them assistance."—PROCTOR *Notes on Earthquakes*, p. 4. (Hum., 1887.)

1889. LIFE, INDIVIDUAL—*Fitting into Broad Scheme of Nature—Bee Seeking Honey Fertilizes Flowers for Future Generations.*—At Torquay I watched for about half an hour a number of these flowers (*Spiranthes*) growing together, and saw three humblebees of two kinds visit them. I caught one and examined its proboscis: on the superior lamina, some little way from the tip, two perfect pollinia were attached, and three other boat-formed disks without pollen; so that this bee had removed the pollinia from five flowers, and had probably left the pollen of three on the stigmas of other flowers. The next day I watched the same flowers for a quarter of an hour, and caught another humblebee at work; one perfect pollinium and four boat-formed disks adhered to its proboscis, one on the top of the other, showing how exactly the same part of the rostellum had each time been touched.

The bees always alighted at the bottom of the spike, and, crawling spirally up it, sucked one flower after the other. I believe humblebees generally act in this manner when visiting a dense spike of flowers, as it is the most convenient method; on the same principle that a woodpecker always climbs up a tree in search of insects. . . . The bee goes first to the lowest flower, and, crawling spirally up the spike, effects nothing on the first spike which she visits till she reaches the upper flowers, and then she withdraws the pollinia. She soon flies to another plant, and, alighting on the lowest and oldest flower, into which a wide passage will have been formed from the greater reflection of the column, the pollinia strike the protuberant stigma. If the stigma of the lowest flower has already been fully fertilized, little or no pollen will be left on its dried surface; but on the next succeeding flower, of which the stigma is adhesive, large sheets of pollen will be left. Then as soon as the bee arrives near the summit of the spike she will withdraw fresh pollinia, will fly to the lower flowers on another plant, and fertilize them: and thus, as she goes her rounds and adds to her store of honey, she continually fertilizes fresh flowers and perpetuates the race of our autumnal *Spiranthes*, which will yield honey to future generations of bees.—DARWIN *Fertilization of Orchids*, ch. 4, p. 113. (A., 1898.)

1890. ——— ——— *Within Life of Organization—Leucocytes and Ciliated Cells in the Body.*—The individual lives of the units [cells] are subordinate to the general life in proportion as this is high. . . . Even in the highest types, however, and even when they are fully developed, unit life does not wholly disappear: it is clearly shown in ourselves. . . . [In the blood] the white corpuscles or leucocytes, retaining the primitive and ameboid character, exhibit individual activities: send out prolongations like pseudopodia, take in organic particles as food, and are independently locomotive. Tho far less numerous than the red corpuscles, yet, as ten thousand are contained in a cubic millimeter of blood—a mass less than a pin's head—it results that the human body is pervaded throughout all its blood-vessels by billions of these separately living units. In the lymph, too, . . . these ameboid units are found. Then we have the curious transitional stage in which units partially embedded and partially free display a partial unit life. These are the ciliated epithelium-cells, lining the air-passages. . . . The inner parts of these unite with their fellows to form an epithelium, and the outer parts of them, immersed either in liquid or semi-liquid (mucus), bear cilia that are in constant motion and "produce a current of fluid over the surface they cover," thus simulating in their positions and actions the cells lining the passages ramifying through a sponge. The partially independent lives of these units is further seen in the fact that after being detached they swim about in water for a time by the aid of their cilia.—SPENCER *Biology*, pt. ii, ch. 2A, p. 186. (A., 1900.)

1891. LIFE, INFINITE AND ETERNAL—*Light Transports Us into.*—The rays of light which fall in silence from the distant splendors of the starry night bring to us, then, the most curious revelations on the state of creation in these inaccessible universes, and prove to us that the substances and forces which we see in activity around us exist there as well as here, producing effects analogous to those which surround our field of view, developing the sphere of our conceptions at the same time as that of our observations, and permitting us to divine the things, the beings, the populations, the unknown works which reproduce in infinitude the spectacles of life, the sports of Nature, and the varied operations of which our solar system presents but an ordinary and incomplete scene. Light transports us into the *infinite life*. It transports us also into the *eternal life*.—FLAMMARION *Popular Astronomy*, bk. vi, ch. 6, p. 616. (A.)

1892. LIFE IN INCESSANT PERIL—*Provision against Earthquakes—"Earthquake Lamps"—"Earthquake Coats."*—The great danger of fire [as the result of earthquake] may partially be obviated by the use of "earthquake lamps," which are so constructed that before they overturn they are extinguished. It is said that in South America some of the inhabitants are ready at any moment to seek refuge in the streets, and they have coats prepared, stocked with provisions and other necessaries, which, if occasion demands, will enable them to spend the night in the open air. These coats [are] called "earthquake coats."—MILNE *Earthquakes*, ch. 7, p. 129. (A., 1899.)

1893 LIFE IN INFUSIONS—*Errors of Experiment—Lifelessness Presumes Correct Manipulation.*—As regards workmanship, moreover, he [the investigator] will not fail to bear in mind that fruitfulness may be due to errors of manipulation, while barrenness involves the presumption of correct experiment. It is only the careful worker that can secure the latter, while it is open to every novice to obtain the former. Barrenness is the result at which the conscientious experimenter, whatever his theoretic convictions may be, ought to aim, omitting no pains to secure it, and resorting only when there is no escape from it to the conclusion that the life observed comes from no source which correct experiment could neutralize or avoid.—TYNDALL *Fragments of Science*, vol. ii, ch. 13, p. 318. (A., 1900.)

1894. LIFE IN OCEAN DEPTHS—*A Few Fossil Forms Still Living—Most Forms Modern Modified.*—Besides proving the existence of a fauna in the sea at all depths and in all regions, the expedition [of the "Challenger," 1873] further proved that the abysmal fauna, taken as a whole, does not possess characters similar to those of the fauna of any of the Secondary or even Tertiary rocks. A few forms, it is true, known to us up to that time only as fossils, were found to be still living in the great depths, but a large majority of the animals of these regions were found to be new and specially modified forms of the families and genera inhabiting shallow waters of modern times. No trilobites, no blastoids, no cystoids, no new ganoids, and scarcely any deep-sea elasmobranchs were brought to light, but the fauna was found to consist mainly of teleosteans, crustacea, cœlentera, and other creatures unlike anything known to have existed in Paleozoic times, specially modified in structure for their life in the great depths of the ocean.—HICKSON *Fauna of the Deep Sea*, ch. 1, p. 14. (A., 1894.)

1895. ——— ——— *How the Mighty Pressure Is Borne—Glass Crushed to Powder.*—In regard to the animal life of the deep sea, the "Challenger" researches do not seem likely to yield any new general result of striking interest. Our previous work had shown that a depth of three miles, a pressure of three tons on the square inch, an entire absence of sunlight, and a temperature below 32° might be sustained by a considerable number and variety of animal types, and this conclusion has been fully confirmed and widely extended. Many specimens have been brought up alive from depths exceeding four miles, at which the pressure was four tons on the square inch, considerably exceeding that exerted by the hydraulic presses used for packing Manchester goods. Even the "protected" thermometers specially constructed for deep-sea sounding were frequently crushed; and a sealed glass tube containing air, having been lowered (within a copper case) to a depth of 2,000 fathoms, was reduced to a fine powder almost like snow by what Sir Wyville Thomson ingeniously characterized as an *im*plosion, the pressure having apparently been resisted until it could no longer be borne, and the whole having been then disintegrated at the same moment. The rationale of the resistance afforded by soft-bodied animals to a pressure which thus affects hard glass is simply that they contain no air, but consist of solids and liquids only; and that since their constituent parts are not subject to more than a very trifling change of bulk, while the equality of the pressure in every direction will prevent any change in their form, there is really nothing to interfere with the ordinary performance of their vital functions.—CARPENTER *Nature and Man*, lect. 11, p. 344. (A., 1889.)

1896. LIFE IN UNEXPECTED PLACES—*Worms that Live in Brine—Every Part of the World Habitable—Why Not Life in Other Worlds?*—The mud in many places [about the salt lakes] was thrown up by numbers of some kind of worm, or annelidous animal. How surprising it is that any creatures should be able to exist in brine, and that they should be crawling among crystals of sulfate of soda and lime! And what becomes of these worms when during the long summer the surface is hardened into a solid layer of salt? Flamingoes in considerable numbers inhabit this lake and breed here; throughout Patagonia, in northern Chile, and at the Galapagos Islands I met with these birds wherever there were lakes of brine. I saw them here wading about in search of food—probably for the worms which burrow in the mud; and these latter probably feed on infusoria or confervæ. Thus we have a little living world within itself, adapted to these inland lakes of brine. . . .

Well may we affirm that every part of the world is habitable! Whether lakes of brine, or those subterranean ones hidden beneath volcanic mountains—warm mineral springs—the wide expanse and depths of the ocean—the upper regions of the atmosphere, and even the surface of perpetual snow—all support organic beings.—DARWIN *Naturalist's Voyage around the World*, ch. 4, p. 66. (A., 1898.)

1897. LIFE, ITS TRANSFORMING POWER—*Exchange of Functions among Vital Organs.*—The roots and leaves of plants are widely differentiated in their functions: by the roots, water and mineral substances are absorbed, while the leaves take in and decompose carbonic acid. Nevertheless, some leaves can absorb water, and in what are popularly called "air-plants" the absorption of water is mainly carried on by them and by the stems. Conversely, the underground parts can partially assume the functions of leaves. The exposed tuber of a potato develops chlorophyl on its surface, and in other cases, as in that of the turnip, roots, properly so called, do the like. In

trees the trunks, which have in great measure ceased to produce buds, recommence producing them if the branches are cut off; sometimes aerial branches send down roots to the earth, and under some circumstances the roots, tho not in the habit of developing leaf-bearing organs, send up numerous suckers. When the excretion of bile is arrested, part goes to the skin and some to the kidneys, which presently suffer under their new task. . . . The excretion of carbonic acid and absorption of oxygen are mainly performed by the lungs, in creatures which have lungs; but in such creatures there continues a certain amount of cutaneous respiration, and in soft-skinned batrachians like the frog this cutaneous respiration is important.—SPENCER *Biology*, pt. ii, ch. 3, p. 208. (A., 1900.)

1898. LIFE, MICROSCOPIC, IN THE ALPINE LAKES — *Organisms Invisible by Transparency.*—Perhaps few of the many thousands of people who annually rock upon the blue lakes among the Alps, feeling perfectly at home, ever dream that in this crystal flood there also float myriads of active animals. But the very monotony of the conditions of life there corresponds to the composition of the pelagic fauna. Besides wheel-animalculæ, representatives of the smallest life *(Infusoria flagellata)* are frolicking among the countless numbers of microscopic algæ; and a few varieties of tiny crabs from a few millimeters to two centimeters in length also inhabit these high lakes in tremendous numbers. They are queer fellows with immense paddle arms and long projections of the body that serve as balancing poles, for they are condemned for life to swim without ever resting in their fluid element, whose specific gravity is of course only a little greater than that of their bodies. Any one confronted for the first time with these animalculæ in a glass of water would seek in vain for them, even if there were hundreds, as it is only after the most minute observation that the dark pigment of the eyes or the faintest coloring of the contents of the intestines will betray their presence. The transparency of the bodily substance of the pelagic sea animals has long been known. Here, as there, this adaptation to the constitution of the water is a means of protecting the delicate creatures from extermination, because it withdraws them from the view of their pursuer. Since, from the tenderness of their bodies, they would not be able to endure the beating of the waves, the minutest crinkling of the water's surface, the gentlest breath of wind, will drive them into depths where the movements on the surface of the water are no longer experienced.—GRAFF *Die Fauna der Alpenseen*, p. 12. (Translated for *Scientific Side-Lights.)*

1899. LIFE MOLDS ENVIRONMENT —*Beavers Changing Surface of Continent.*—Beaver-dams afford still another illustration of the manner in which drainage is obstructed and lakes formed by organic agencies. Beavers formerly lived over nearly the whole of North America, and are still found in limited numbers in the Northern States and Canada, and extending southward along the Cordilleras at least as far as New Mexico. The dams they constructed with great intelligence and skill, across small streams, retained drift logs and floating leaves, thus leading to the accumulation of deposits which obstructed the drainage for a long time after they had been abandoned by the animals that built them. The ponds and swamps due to the work of beavers number tens of thousands, and have produced important changes in the minor features of the surface of the continent. Many of these ponds, after becoming choked with vegetation and converted into peat swamps, have been drained and furnish rich garden-lands.—RUSSELL *Lakes of North America*, ch. 1, p. 27. (G. & Co., 1895.)

1900. LIFE, NATURAL, DEFINED—*The Sum Total of the Functions that Resist Death—Life, Spiritual, the Sum Total of the Functions that Resist Sin.*—This law, which is true for the whole plant-world, is also valid for the animal and for man. Air is not life, but corruption—so literally corruption that the only way to keep out corruption, when life has ebbed, is to keep out air. Life is merely a temporary suspension of these destructive powers; and this is truly one of the most accurate definitions of life we have yet received—"the sum total of the functions which resist death."

Spiritual life, in like manner, is the sum total of the functions which resist sin. The soul's atmosphere is the daily trial, circumstance, and temptation of the world. And as it is life alone which gives the plant power to utilize the elements, and as, without it, they utilize it, so it is the spiritual life alone which gives the soul power to utilize temptation and trial; and without it they destroy the soul.—DRUMMOND *Natural Law in the Spiritual World*, essay 2, p. 93. (H. Al.)

1901. LIFE, NATURE OF, UNKNOWN TO SCIENCE—Science has cast no light on the ultimate nature of life. But whatever it be, it has evidently fundamental elements which are the same throughout the whole circle of the organic world.—ARGYLL *Unity of Nature*, ch. 2, p. 29. (Burt.)

1902. LIFE, NONE, WITHOUT ANTECEDENT LIFE—*Refutation of the Theory of Spontaneous Generation.*—Standing on the Mer de Glace, near the Montanvert, he [Pasteur] snipped off the ends of a number of hermetically sealed flasks containing organic infusions. One out of twenty of the flasks thus supplied with glacier air showed signs of life afterwards, while eight out of twenty of the same infusions, supplied with the air of the plains, became crowded with

life. He took his flasks into the caves under the Observatory of Paris, and found the still air in these caves devoid of generative power. These and other experiments, carried out with a severity perfectly obvious to the instructed scientific reader, and accompanied by a logic equally severe, restored the conviction that, even in these lower reaches of the scale of being, life does not appear without the operation of antecedent life.—TYNDALL *Floating Matter of the Air,* essay 5, p. 285. (A., 1895.)

1903. LIFE NOT IN MATERIAL ELEMENTS—*The Water Is Left, the Wave Goes On—Spirit Not Revealed to Sense.*—Just as the flame remains the same in appearance, and continues to exist with the same form and structure, altho it draws every minute fresh combustible vapor, and fresh oxygen from the air, into the vortex of its ascending current; and just as the wave goes on in unaltered form, and is yet being reconstructed every moment from fresh particles of water, so also in the living being, it is not the definite mass of substance, which now constitutes the body, to which the continuance of the individual is attached. For the material of the body, like that of the flame, is subject to continuous and comparatively rapid change—a change the more rapid, the livelier the activity of the organs in question. Some constituents are renewed from day to day, some from month to month, and others only after years. That which continues to exist as a particular individual is like the flame and the wave—only the form of motion which continually attracts fresh matter into its vortex and expels the old. The observer with a deaf ear only recognizes the vibration of sound as long as it is visible and can be felt, bound up with heavy matter. Are our senses, in reference to life, like the deaf ear in this respect?—HELMHOLTZ *Popular Lectures,* lect. 4, p. 195. (L. G. & Co., 1898.)

1904. LIFE OF WANDERING GERMS—*Unseen Perils—Long-enduring Menace of Evil Once Set Afloat—The Source of Life Infected.*—So essentially does the bacterial content of air depend upon the facility with which certain bacteria withstand drying that Dr. Eduardo Germano has addressed himself first to drying various pathogenic species and then to mixing the dried residue with sterilized dust and observing to what degree the air becomes infected. Typhoid appears to withstand comparatively little desiccation without losing its virulence. Nevertheless, it is able to retain vitality in a semidried condition, and it is owing to this circumstance in all probability that it possesses such power of infection. Diphtheria [is], on the other hand, capable of lengthened survival outside the body. . . . This is not the case with cholera or plague. Dr. Germano classifies bacteria, as a result of his researches, into three groups: first, those like plague, typhoid, and cholera, which cannot survive drying for more than a few hours; second, those like the bacilli of diphtheria, . . . which can withstand it for a longer period; thirdly, those like tubercle, which can very readily resist drying for months and yet retain their virulence. . . . Miquel has recently demonstrated that soil bacteria or their spores can remain alive in hermetically sealed tubes for as long a time as sixteen years. Even at the end of that period the soil inoculated into a guinea-pig produced tetanus.—NEWMAN *Bacteria,* ch. 3, p. 108. (G. P. P., 1899.)

1905. LIFE ON THE MOONS OF JUPITER—*Glorious Aspect of Jupiter as Seen from His Satellites—The Giant Planet a Minor Sun.*—Why should not the moons of Jupiter be inhabited, instead of Jupiter himself, and Jupiter be appointed to compensate them (not they him) for the smallness of the direct supply of solar light and heat? . . . For to them the sun is a minute body, showing a disk scarcely equal to one twenty-fifth of the sun's disk as we see him; but the glorious disk of Jupiter, varying at the several moons from an area 1,600 times as great as their sun to an area 35,000 times his, and marked by the wonderfully beautiful colors of which our telescopes afford a faint idea, must be an amazing object of contemplation. The changes also which take place in his aspect as he turns round on his axis, and also as real changes take place in his cloud envelope, must be singularly impressive and suggestive. We may well believe that if there are reasoning creatures on the worlds which circle around Jupiter, they have as good reason as we ourselves to say, "The heavens declare the glory of God, the firmament showeth his handiwork."—PROCTOR *Expanse of Heaven,* pp. 88-93. (L. G. & Co., 1897.)

1906. LIFE, PHYSICAL, COOPERATION IN—*The Human Body a Colony of Cell-workers—Division Resulting in Harmony.*—If we think of the countless operations which have to be undertaken from hour to hour to maintain our bodies in action, we may begin to realize what perfect cooperation really means, and what this colonial constitution of ours implies. For example, saliva has to be secreted, for the purpose of digestion, in the mouth, and for other functions as well. This fluid is supplied by three pairs of salivary glands. Now, the working and essential parts of these glands are living cells, which, out of the blood (as the raw material) supplied to the glands, secrete saliva, which is the manufactured product. Again, tears have perpetually to be made for washing the eyes. This secretion is supplied by a couple of tear glands. Here, again, are cells, different from those of the salivary glands, and making out of the blood a very different secretion to that of the mouth. The cells of the gastric glands of the stomach make, from the blood, gastric juice. . . . The brain-cells guide

and direct the body's highest acts equally with lower nervous operations. Cells in the skin repair our wounds and throw off other cells which are cast away as the outer skin wears. The bone-cells renew and repair that dense structure, and build up the solid portions of the frame. In a word, every act of life is performed by the cells, each group of which remains distinct as a colony of workers charged with the performance of a specific duty. Truly, then, it may be held that our life is a divided existence physically; while from another point of view it is an harmonious existence, because of the perfect cooperation of these wonderful workers of the body—the living cells.—ANDREW WILSON *Glimpses of Nature,* ch. 25, p. 82. (Hum., 1892.)

1907. LIFE, PROCESSES OF, BEYOND VOLITION—*The Physical Man Largely an Automaton—Natural Laws Bear Him On.*—Men need only reflect on the automatic processes of their natural body to discover that this is the universal law of life. What does any man consciously do, for instance, in the matter of breathing? What part does he take in circulating the blood, in keeping up the rhythm of his heart? What control has he over growth? What man by taking thought can add a cubit to his stature? What part voluntarily does man take in secretion, in digestion, in the reflex actions? In point of fact is he not after all the veriest automaton, every organ of his body given him, every function arranged for him, brain and nerve, thought and sensation, will and conscience, all provided for him ready made?—DRUMMOND *Natural Law in the Spiritual World,* essay 8, p. 275. (H. Al.)

1908. LIFE REVERSES RULES OF THE INORGANIC — *Motion Characterizes Life.*—The chemist equally regards chemical change in a body as the effect of the action of something external to the body changed. A chemical compound once formed would persist forever if no alteration took place in surrounding conditions.

But to the student of life the aspect of Nature is reversed. Here, incessant, and, so far as we know, spontaneous change is the rule, rest the exception—the anomaly to be accounted for. Living things have no inertia and tend to no equilibrium.—HUXLEY *Lay Sermons,* serm. 5, p. 73. (A., 1895.)

1909. LIFE RUNS IN GROOVES OF HABIT—*Instinct and Reason.*—When we look at living creatures from an outward point of view, one of the first things that strike us is that they are bundles of habits. In wild animals, the usual round of daily behavior seems a necessity implanted at birth; in animals domesticated, and especially in man, it seems, to a great extent, to be the result of education. The habits to which there is an innate tendency are called instincts; some of those due to education would by most persons be called acts of reason. It thus appears that habit covers a very large part of life, and that one engaged in studying the objective manifestations of mind is bound at the very outset to define clearly just what its limits are.—JAMES *Psychology,* vol. i, ch. 4, p. 104. (H. H. & Co., 1899.)

1910. LIFE, SOCIAL, DEPENDS UPON MOTHERHOOD—*So Ethics and Religion—Through Infancy to the Kingdom of Heaven.*—See then what the savage mother and her babe have brought into the world. When the first mother awoke to her first tenderness and warmed her loneliness at her infant's love, when for a moment she forgot herself and thought upon its weakness or its pain, when by the most imperceptible act or sign or look of sympathy she expressed the unutterable impulse of her motherhood, the touch of a new creative hand was felt upon the world. However short the earliest infancies, however feeble the sparks they fanned, however long heredity took to gather fuel enough for a steady flame, it is certain that once this fire began to warm the cold hearth of Nature and give humanity a heart, the most stupendous task of the past was accomplished. . . . "From of old we have heard the monition, 'Except ye be as babes ye cannot enter the kingdom of heaven'; the latest science now shows us—tho in a very different sense of the words—that unless we had been as babes, the ethical phenomena which give all its significance to the phrase 'Kingdom of heaven' would have been nonexistent for us. Without the circumstances of infancy we might have become formidable among animals through sheer force of sharpwittedness. But except for these circumstances we should never have comprehended the meaning of such phrases as 'self-sacrifice' or 'devotion.' The phenomena of social life would have been omitted from the history of the world, and with them the phenomena of ethics and religion." [Fiske, "Cosmic Philosophy," vol. ii, p. 363.]—DRUMMOND *Ascent of Man,* ch. 8, p. 290. (J. P., 1900.)

1911. LIFE, SOCIAL, QUALITIES THAT GIVE PREEMINENCE IN—*Struggle in Conversation.*—In every conversation there is a victor and a vanquished, not alone because for the moment, or later, the interlocutor renounces [his own] ideas for those of others, but still more because one of the speakers takes, as we say, the *dé* [the die—*i. e.,* the engrossing share] of the conversation. The one takes it, the other allows him to. In general, mental superiority establishes this subordination, but superiority alone is not sufficient. There is also necessary a certain eloquence, a certain dash of assurance and audacity. In the general conversations of the salons these subsidiary qualities are still more indispensable than in friendly chat between two. One who is obscure or unknown discovers that even

in society it would be impossible to seize the world and keep it long enough to set forth his ideas. In the salon, eloquence and audacity are indispensable. We often see also a chatterer not possessing a single original idea exercising great influence upon the drawing-room, while men of real merit are completely effaced by reason of modesty and timidity.—NOVICOW *Les Luttes entre Sociétés humaines et leur Phases successives.* (Translated for *Scientific Side-Lights.)*

1912. LIFE, SPIRITUAL, OF MAN—*Mysterious Communion of Nature with.*—The impression which is left on the mind by the aspect of natural scenery is less determined by the peculiar character of the region than by the varied nature of the light through which we view, or mountain or plain, sometimes beaming beneath an azure sky, sometimes enveloped in the gloom of lowering clouds. Thus, too, descriptions of Nature affect us more or less powerfully in proportion as they harmonize with the condition of our own feelings. For the physical world is reflected with truth and animation on the inner susceptible world of the mind. Whatever marks the character of a landscape—the profile of mountains, which in the far and hazy distance bound the horizon; the deep gloom of pine forests; the mountain torrent, which rushes headlong to its fall through overhanging cliffs—all stand alike in an ancient and mysterious communion with the spiritual life of man. From this communion arises the nobler portion of the enjoyment which Nature affords. —HUMBOLDT *Views of Nature,* p. 154. (Bell, 1896.)

1913. LIFE SUBJUGATES CHEMISTRY—Whatever the relationship may be between living organisms and the elements, or elementary forces of external Nature, it certainly is not the relationship of mere chemical affinities. On the contrary, the union which these affinities by themselves produce can only be reached through the dissolution and destruction of living bodies. The subjugation of chemical forces under some higher form of energy which works them for the continued maintenance of a separate individuality—this is of the very essence of life. The destruction of that separateness or individuality is of the very essence of death.—ARGYLL *Unity of Nature,* ch. 2, p. 34. (Burt.)

1914. LIFE SURROUNDED BY AN ATMOSPHERE OF DESTRUCTION—*Disease a Conflict between Victim and Bacteria.*—But the action of living contagia extends beyond the domain of the surgeon. The power of reproduction and indefinite self-multiplication which is characteristic of living things, coupled with the undeviating fact of contagia "breeding true," has given strength and consistency to a belief long entertained by penetrating minds, that epidemic diseases generally are the concomitants of parasitic life. "There begins to be faintly visible to us a vast and destructive laboratory of Nature wherein the diseases which are most fatal to animal life, and the changes to which dead organic matter is passively liable, appear bound together by what must at least be called a very close analogy of causation." According to this view, which, as I have said, is daily gaining converts, a contagious disease may be defined as a conflict between the person smitten by it and a specific organism which multiplies at his expense, appropriating his air and moisture, disintegrating his tissues, or poisoning him by the decompositions incident to its growth.—TYNDALL *Floating Matter of the Air,* essay 5, p. 288. (A., 1895.)

1915. LIFE, TENACITY OF—*The Oldest Thing Alive in Germany.*—Of all things in the soil of Germany the most tenacious of life is a tender rose. More than eight hundred years ago the rose-bush at the Cathedral of Hildesheim received special care and regard as a venerable, antique monument of the past.—PFUHL *Was geboren ist auf Erden muss zu Erd-Asche werden (17 Serie).* (Translated for *Scientific Side-Lights.)*

1916. LIFE THE CAUSE OF ORGANIZATION—*Science Has No Explanation of Vital Force.*—This [that mind is inconceivable except in connection with a material organ] would be a very unsafe conclusion even if the connection between our bodies and our minds were of such a nature that we could not conceive the separation of the two. But so far is this from being the case that, as Professor Tyndall most truly says, "it is a connection which we know only as an inexplicable fact, and we try to soar in a vacuum when we seek to comprehend it." The universal testimony of human speech—that sure record of the deepest metaphysical truths—proves that we cannot but think of the body and the mind as separate—of the mind as our proper selves, and of the body as indeed external to it. Let us never forget that life, as we know it here below, is the antecedent or the cause of organization, and not its product; that the peculiar combinations of matter which are the homes and abodes of life are prepared and shaped under the control and guidance of that mysterious power which we know as vitality; and that no discovery of science has ever been able to reduce it to a lower level, or to identify it with any purely material force.—ARGYLL *Unity of Nature,* ch. 8, p. 182. (Burt.)

1917. LIFE THE MIGHTIEST OF FORCES—*Living Plants Wedge Dead Rocks Asunder—Prepare New Soil for Their Own Growth.*—Living plants themselves attack rocks, and by means of the acids in their roots dissolve out the mineral matters required by the organisms. Further, their roots penetrate the natural division-planes of rocks and wedge these asunder; and thus, by allowing freer percolation of water, they

prepare the way for more rapid disintegration. Nor can we neglect the action of tunneling and burrowing animals, some of which aid considerably in the work of destruction. There can be no doubt, for example, that worms, as Darwin has shown, play an important part in the formation of soil, which is simply rotted rock plus organic matter.—GEIKIE *Earth Sculpture*, ch. 2, p. 29. (G. P. P., 1898.)

1918. LIFE, TRANSITORINESS OF—*Leaves Scarce a Trace on Earth.*—As to the dry land, so far from being the receptacle of fresh accessions of matter, it is exposed almost everywhere to waste away. Forests may be as dense and lofty as those of Brazil, and may swarm with quadrupeds, birds, and insects, yet at the end of ten thousand years one layer of black mold, a few inches thick, may be the sole representative of those myriads of trees, leaves, flowers, and fruits, those innumerable bones and skeletons of birds, quadrupeds, and reptiles, which tenanted the fertile region. Should this land be at length submerged, the waves of the sea may wash away in a few hours the scanty covering of mold, and it may merely impart a darker shade of color to the next stratum of marl, sand, or other matter newly thrown down.—LYELL *Principles of Geology*, bk. i, ch. 13, p. 188. (A., 1854.)

1919. LIFE, ULTIMATE FACTS OF—Sensation, perception, consciousness, and thought—these, if they are not the very essence of life, are at least—in their order—its highest accompaniments and result. They are the ultimate facts, they are the final realities, to which all lesser adjustments are themselves adjusted.—ARGYLL *Unity of Nature*, ch. 2, p. 34. (Burt.)

1920. LIFE, UNIVERSAL DIFFUSION OF—*Insects on Highest Mountain Peaks—Condor Soars Above the Andes.*—When the active spirit of man is directed to the investigation of Nature, or when in imagination he scans the vast fields of organic creation, among the varied emotions excited in his mind there is none more profound or vivid than that awakened by the universal profusion of life. Everywhere—even near the ice-bound poles—the air resounds with the song of birds and with the busy hum of insects. Not only the lower strata, in which the denser vapors float, but also the higher and ethereal regions of the air, teem with animal life. Whenever the lofty crests of the Peruvian Cordilleras, or the summit of Mont Blanc, south of Lake Leman, have been ascended, living creatures have been found even in these solitudes. On the Chimborazo, which is upwards of eight thousand feet higher than Mount Etna, we saw butterflies and other winged insects. Even if they are strangers carried by ascending currents of air to those lofty regions, whither a restless spirit of inquiry leads the toilsome steps of man, their presence nevertheless proves that the more pliant organization of animals may subsist far beyond the limits of the vegetable world. The condor, that giant among the vultures, often soared above us at a greater altitude than the summits of the Andes.—HUMBOLDT *Views of Nature*, p. 210. (Bell, 1896.)

1921. ———— *Vegetation on Snow, in Caves and Mines, and Under Glaciers.*—The strong and beneficial influence exercised on the feelings of mankind by the consideration of the diffusion of life throughout the realms of Nature is common to every zone, but the impression thus produced is most powerful in the equatorial regions, in the land of palms, bamboos, and arborescent ferns, where the ground rises from the shore of seas rich in mollusca and corals to the limits of perpetual snow. The local distribution of plants embraces almost all heights and all depths. Organic forms not only descend into the interior of the earth where the industry of the miner has laid open extensive excavations and sprung deep shafts, but I have also found snow-white stalactitic columns encircled by the delicate web of an *Usnea* in caves where meteoric water could alone penetrate through fissures. *Podurellæ* penetrate into the icy crevices of the glaciers on Mount Rosa, the Grindelwald, and the Upper Aar; the *Chionæa araneoides* described by Dalman, and the microscopic *Discerea nivalis* (formerly known as *Protococcus*), exist in the polar snow as well as in that of our high mountains. The redness assumed by the snow after lying on the ground for some time was known to Aristotle, and was probably observed by him on the mountains of Macedonia.—HUMBOLDT *Cosmos*, vol. i, p. 344. (H., 1897.)

1922. LIFE, VEGETABLE, LACKING IN OCEAN DEPTHS—It has not been determined yet with any degree of accuracy where we are to place the limit of vegetable life, but it seems probable that below a hundred fathoms no organisms, excepting a few parasitic fungi, are to be found that can be included in the vegetable kingdom. While then the researches of recent times have proved beyond a doubt that there is no depth of the ocean that can be called azoic, they have but confirmed the perfectly just beliefs of the older naturalists that there is a limit where vegetable life becomes extinct. It is not difficult to see the reason for this. All plants, except a few parasites and saprophytes, are dependent upon the influence of direct sunlight, and as it has been shown . . . that the sunlight cannot penetrate more than a few hundred fathoms of seawater, it is impossible for plants to live below that depth.—HICKSON *Fauna of the Deep Sea*, ch. 2, p. 42. (A., 1894.)

1923. LIFE VIEWED AS CONTINUOUS—*Reproduction an Essential Attribute.*—Reproduction is in truth an essential attribute of living matter, just as is the growth which gives rise to it. It is as impossible

to imagine life enduring without reproduction as it would be to conceive life lasting without the capacity for absorption of food and without the power of metabolism. Life is continuous and not periodically interrupted: ever since its first appearance upon the earth, in the lowest organisms, it has continued without break: the forms in which it is manifested have alone undergone change. Every individual alive to-day—even the very highest—is to be derived in an unbroken line from the first and lowest forms.—WEISSMAN *Heredity*, vol. i, p. 161. (C. U. P., 1892.)

1924. LIFE, WANTON DESTRUCTION OF—*Grace of Form and Motion of the Great Blue Heron—Irreparable Loss.*—The presence of a stately great blue heron or "crane" adds an element to the landscape which no work of man can equal. Its grace of form and motion, emphasized by its large size, is a constant delight to the eye: it is a symbol of the wild in Nature; one never tires of watching it. What punishment, then, is severe enough for the man who robs his fellows of so pure a source of enjoyment? A rifle-ball turns this noble creature into a useless mass of flesh and feathers; the loss is irreparable. Still, we have no law to prevent it. Herons are said to devour large numbers of small fish. But is not the laborer worthy of his hire? Are the fish more valuable than this, one of the grandest of birds?—CHAPMAN *Bird-Life*, ch. 7, p. 95. (A., 1900.)

1925. LIFE WITHOUT MOTIVE OR PURPOSE—*Sensations without Ideas—The Brainless Pigeon—Spontaneity Destroyed.*—To illustrate this sensori-motor or instinctive action, we may take the results of Flourens's well-known experiment of removing the cerebral hemispheres of a pigeon. What happens? The pigeon seemingly loses at once all intelligence and all power of spontaneous action. It appears as if it were asleep; yet, if thrown into the air, it will fly. If laid on its back, it struggles on to its legs again; the pupil of the eye contracts to light, and, if the light be very bright, the eyes are shut. It will dress its feathers if they are ruffled, and will sometimes follow with a movement of its head the movement of a candle before it; and, when a pistol is fired off, it will open its eyes, stretch its neck, raise its head, and then fall back into its former attitude. It is quite evident from this experiment that general sensibility and special sensations are possible after the removal of the hemispheres; but they are not then transformed into ideas. The impressions of sense reach and affect the sensory centers, but they are not intellectually perceived; and the proper movements are excited, but these are reflex or automatic. There are no ideas, there is no true spontaneity; and the animal would die of hunger before a plateful of food, tho it will swallow it when pushed far enough into its mouth to come within the range of the reflex acts of deglutition.—MAUDSLEY *Body and Mind*, lect. 1, p. 20. (A., 1898.)

1926. LIFTING OF HEAVY STONES BY PRIMITIVE MAN—*Wedges and Cobwork.*—The only puzzle the modern student can have is to conceive how the ancient engineer lifted [such] great weights. If he could lift them he could move them. It was within the ability of a company of American Indians in several areas to hammer down any great stone into any form. It was customary for them, as tribes, to all engage in the same operation in hauling logs, or seines, or boats, or stones, in rowing and dancing. The problem is somewhat like that of Archimedes. "Given a rope long enough and a cribwork strong enough," and any modern savage people will undertake to set up the monuments of Brittany. In point of fact the ancient Americans did quarry single stones weighing three hundred tons, did move them great distances and set them in place. In the copper mines of Michigan was discovered a huge nugget of copper resting still on a mass of cobwork. Around were wedges and mauls, and, by means of shoring up alternate sides after lifting them by wedges, the engineers had hoisted the mass twenty-six feet. This is the only historic example I have found of actual work done.—MASON *Aboriginal American Mechanics* (*Memoirs of the International Congress of Anthropology*, p. 83). (Sch. P. C.)

1927. LIGHT AND SOUND NOT MERE SENSATIONS—*Existent Waves External to Human Organism.*—Until modern science had established its methods of physical investigation, light and sound were known as sensations only; that is to say, they were known in terms of the mental impressions which they immediately produce upon us, and in no other terms whatever. There was no proof that in these sensations we had any knowledge "in themselves" of the external agencies which produce them. But now all this is changed. Science has discovered what these two agencies are "in themselves"; that is to say, it has defined them under aspects which are totally distinct from seeing or hearing, and is able to describe them in terms addressed to wholly different faculties of conception. Both light and sound are in the nature of undulatory movements in elastic media—to which undulations our organs of sight and hearing are respectively adjusted or "attuned." In these organs, by virtue of that adjustment or attuning, these same undulations are "translated" into the sensations which we know. It thus appears that the facts as described to us in this language of sensation are the true equivalent of the facts as described in the very different language of intellectual analysis. The eye is now understood to be an apparatus for enabling the mind instantaneously to appreciate differences of motion which are of almost incon-

ceivable minuteness. The pleasures we derive from the harmonies of color and of sound, altho mere sensations, do correctly represent the movement of undulations in a definite order; whilst those other sensations which we know as discords represent the actual clashing and disorder of interfering waves. Thus it is that in breathing the healthy air of physical discoveries such as these, altho the limitations of our knowledge continually haunt us, we gain nevertheless a triumphant sense of its certainty and of its truth.—ARGYLL *Unity of Nature*, ch. 4, p. 94. (Burt.)

1928. LIGHT A RESULT OF CORRELATION—*The Retina Attuned to Ethereal Vibrations.*—Light itself, therefore, is discovered to be merely a relative term—a word, in short, denoting nothing but an external correlation between the retina and vibrations of a certain kind and quality. Now what is the language which Professor Tyndall is constrained to use in explanation of facts so difficult of conception? It is the language of mechanism, of mental purpose and design. "It is not," he says, "the size of a wave which determines its power of producing light; it is, broadly speaking, *the fitness of the wave to the retina*. The ethereal pulses must follow each other with a certain rapidity of succession before they can produce light, and if their rapidity exceed a certain limit, they also fail to produce light. *The retina is attuned*, if I may use the term, *to a certain range of vibrations*, beyond which, in both directions, it ceases to be of use." These are indeed wonderful correlations which reveal to us fittings and adjustments of which we had no previous conception; but they give us no glimmering, even, of knowledge as to the physical causes which have "attuned" a material organ so as to catch certain ethereal pulsations in the external world, and to make these the means of conveying to man's intelligence the enjoyment and the power of sight.—ARGYLL *Reign of Law*, ch. 5, p. 153. (Burt.)

1929. LIGHT, ARTIFICIAL—*Primitive Methods Lasted Till Recent Times—The Link-boys of London.*—The first illuminants were probably torches made of resinous woods, which will give a flame for a considerable time. Then the resin exuding from many kinds of trees would be collected and applied to sticks or twigs, or to some fibrous materials tied up in bundles, such as are still used by many savage peoples, and were used in the old baronial halls. For outdoor lights torches were used almost down to our times, an indication of which is seen in the iron torch-extinguishers at the doors of many of the older West End houses [of London]; while, before the introduction of gas, link-boys were as common in the streets as match-sellers are now. Then came lamps, formed of small clay cups, holding some melted animal fat and a fibrous wick; and, somewhat later, rushlights and candles; . . . but the three modes of obtaining illumination for domestic purposes remained entirely unchanged in principle, and very little improved, throughout the whole period of history down to the end of the eighteenth century.—WALLACE *The Wonderful Century*, ch. 4, p. 27. (D. M. & Co., 1899.)

1930. LIGHT A SIGN OF UNITY—*Its Waves Pervade All Space.*—Nor is gravitation the only agency which brings home to us the unity of the conditions which prevail among the worlds. There is another: light—that sweet and heavenly messenger which comes to us from the depths of space, telling us all we know of other worlds, and giving us all that we enjoy of life and beauty on our own. . . . Light is a wave, or an undulatory vibration, and such vibrations can only be propagated in a medium which, however thin, must be material. That this substance is at all like the chemical substance that we call "ether," is of course a metaphor. It is a good metaphor only in so far as the vapor of ether represents to us a form of matter which is very thin, invisible, and impalpable. . . . Light, therefore, reveals to us the fact that we are united with the most distant worlds, and with all intervening space, by some ethereal atmosphere, which embraces and holds them all.—ARGYLL *Unity of Nature*, ch. 1, p. 6. (Burt.)

1931. LIGHT AS KNOWN TO ANCIENTS—*Lens at Nineveh—Combination of Lenses Modern—Telescope and Microscope.*—About light the ancients knew more [than about sound]. Their polished metal mirrors, flat and curved, had taught them the first principles of reflection. Nor were they ignorant of refraction; they already knew the familiar experiment of putting a ring in a basin and pouring in water till it becomes visible. A rock-crystal lens has been dug up at Nineveh, and the Greeks and Romans were well acquainted with glass lenses. One is surprised that neither the Arab astronomers, who knew a good deal of optics, nor Roger Bacon, who in the thirteenth century gave an intelligent account of their science, ever seem to have combined two lenses into a telescope. It was not till the seventeenth century that a telescope is plainly mentioned in Holland, and Galileo, hearing of it, made the famous instrument with which he saw Jupiter's moons, and revolutionized men's ideas of the universe. The microscope and telescope may be called inverted forms of one another, and their inventions came nearly together. By these two instruments the range of man's vision has been so vastly extended beyond his unaided eyesight that animalcules under a ten-thousandth of an inch long can now be watched through all the stages of their life, while stars whose distance from the earth is hundreds of thousands of billions of miles

are within the maps of the universe.—Tylor *Anthropology,* ch. 13, p. 326. (A., 1899.)

1932. LIGHT, DEPOLARIZATION OF—*A New Solid Interposed Scatters Darkness.*—When the tourmalins [tourmalin prisms placed in the path of a ray of light] are crossed, the space where they cross each other is black. But the least obliquity on the part of the crystals permits light to get through both. Now suppose, when the two plates are crossed, that we interpose a third plate of tourmalin between them, with its axis oblique to both. A portion of the light transmitted by the first plate will get through this intermediate one. But, after it has got through, its plane of vibration is changed: it is no longer perpendicular to the axis of the crystal in front. Hence it will get through that crystal. Thus, by pure reasoning, we infer that the interposition of a third plate of tourmalin will in part abolish the darkness produced by the perpendicular crossing of the other two plates. I have not a third plate of tourmalin; but the talc or mica which you employ in your stoves is a more convenient substance, which acts in the same way. Between the crossed tourmalins I introduce a film of this crystal with its axis oblique to theirs. You see the edge of the film slowly descending, and, as it descends, light takes the place of darkness. The darkness, in fact, seems scraped away, as if it were something material. This effect has been called, naturally but improperly, *depolarization.*—Tyndall *Lectures on Light,* lect. 3, p. 122. (A., 1898.)

1933. LIGHT, DOUBLE REFLECTION OF, FROM FILMS—*Bubbles as Teachers of Science—Extinction of Waves by Interference Gives Prismatic Colors.*—Whence, then, are derived the colors of the soap-bubble? Imagine a beam of white light impinging on the bubble. When it reaches the first surface of the film, a known fraction of the light is reflected back. But a large portion of the beam enters the film, reaches its second surface, and is again in part reflected. The waves from the second surface thus turn back and hotly pursue the waves from the first surface. And, if the thickness of the film be such as to cause the necessary retardation, the two systems of waves interfere with each other, producing augmented or diminished light, as the case may be.

But, inasmuch as the waves of light are of different lengths, it is plain that, to produce self-extinction in the case of the longer waves, a greater thickness of film is necessary than in the case of the shorter ones. Different colors, therefore, must appear at different thicknesses of the film.—Tyndall *Lectures on Light,* lect. 2, p. 66. (A., 1898.)

1934. LIGHT, ELECTRIC—*Advantages of—Oxygen Not Consumed—Air Not Vitiated—Science Increases Healthfulness and Safety.*—Every other artificial source of light, whether gas, or candles, or oil, takes out of the air the oxygen which is necessary for the support of life, and gives back, in return, carbonic acid, which tends to produce suffocation; whereas the incandescent lamp takes nothing from the air, and it gives nothing to it but pure and simple light. Again, the incandescent lamp produces far less heat . . . for a given amount of illumination than other sources of light. Once more, oil and candles and gas often produce a disagreeable smell, and always produce more or less smoke, which discolors the walls and ceilings of your rooms, injures your paintings and the bindings of your books, and disfigures every kind of decorative work. The incandescent lamp produces no smoke, and what to many is, perhaps, even more important, it produces no smell.

A very remarkable testimony to the healthfulness of the incandescent lamp, as compared with gas, was given by Mr. Preece, at the meeting of the British Association recently held in Bath. About two years ago, the electric light was introduced into the Central Post Office Savings Bank in London, and since that time the leaves of absence, on account of illness, of members of the staff have been reduced by an amount equal to an average of two days a year for each person. This, he said, was equivalent to a gain to the service of the time of eight clerks, and represented a saving of about £640 a year in salaries.

As regards the danger of fire, it is not easy to exaggerate the extraordinary safety of the incandescent lamp. I would only call your attention to one fact. In dealing with gas and candles we are dealing with a naked flame, whose function it is to set fire to whatever touches it; in the case of the incandescent lamp we are dealing with a light shut up in a prison-house of glass, and if we chance to break the glass we at the same moment put out the light.—Molloy *The Electric Light,* lect. 2, p. 37. (Hum., 1889.)

1935. ——— ——— *Scarcely Affects Germs.*—It has been found that the electric light has but little action upon bacteria, tho that which it has is similar to sunlight [*i. e.,* destructive]. Recent experiments with the Röntgen rays have given negative results.—Newman *Bacteria,* ch. 1, p. 25. (G. P. P., 1899.)

1936. LIGHT ESSENTIAL TO GROWTH OF PLANTS—*Sun the Source of Plant-life.*—Light, which is now known to modify many inorganic compounds—light, which works those mechanical changes utilized in photography, causes the combinations of certain gases, alters the molecular arrangements of many crystals, and leaves traces of its action even on substances that are extremely stable—may be expected to produce marked effects on substances so complex and unstable as those which make up organic bodies. . . . The molecular

changes wrought by light in animals are of but secondary moment. . . .

On plants, however, the solar rays that produce in us the impression of yellow, are the immediate agents of those molecular changes through which are hourly accumulated the materials for further growth. Experiments have shown that when the sun shines on living leaves, they begin to exhale oxygen and to accumulate carbon and hydrogen—results which are traced to the decomposition, by the solar rays, of the carbonic acid and water absorbed. It is now an accepted conclusion that, by the help of certain classes of the ethereal undulations penetrating their leaves, plants are enabled to separate from the associated oxygen those two elements of which their tissues are chiefly built up.—SPENCER *Biology*, pt. i, ch. 2, p. 30. (A., 1900.)

1937. LIGHT IN OCEAN DEPTHS—*Few Animals Wholly Blind.*—The conditions in the deep sea are not quite the same [as in terrestrial caves]. In some regions there is probably a very considerable illumination by phosphorescent light, and it is quite possible that many of the characteristic deep-sea forms may occasionally wander into shallower regions where faint rays of sunlight penetrate, or even that the young stages of some species may be passed at or near the surface of the sea. Taking these points into consideration, then, it is not surprising to find that, in the deep seas, there are very few animals, belonging to families usually provided with eyes, that are quite blind.—HICKSON *Fauna of the Deep Sea*, ch 4, p. 68. (A., 1894.)

1938. ——— ——— *Illumination by Phosphorescent Animals—Like a City Street at Night.*—If we may be allowed to compare the light of abysmal animals with that of surface forms, we can readily imagine that some regions of the sea may be as brightly illuminated as a European street is at night—an illumination with many very bright centers and many dark shadows, but quite sufficient for a vertebrate eye to distinguish readily and at a considerable distance both form and color.—HICKSON *Fauna of the Deep Sea*, ch. 2, p. 25. (A., 1894.)

1939. LIGHT, LAW OF ITS ABSORPTION—*Each Substance Selects and Stops Its Own Kind of Light—Identification by Spectroscope.*—A general principle first enunciated by Kirchhoff in a communication to the Berlin Academy, December 15, 1859, and afterwards more fully developed by him . . . may be expressed as follows: Substances of every kind are opaque to the precise rays which they emit at the same temperature: that is to say, they stop the kinds of light or heat which they are then actually in a condition to radiate. But it does not follow that cool bodies absorb the rays which they would give out if sufficiently heated. Hydrogen at ordinary temperatures, for instance, is almost perfectly transparent, but if raised to the glowing point—as by the passage of electricity—it then becomes capable of arresting, and at the same time of displaying in its own spectrum, light of four distinct colors.—CLERKE *History of Astronomy*, pt. ii, ch. 1, p. 168. (Bl., 1893.)

1940. LIGHT OF PHOSPHORESCENCE IN THE BANDA SEAS—In the Banda Seas, on calm nights, the whole surface of the ocean seems to be a sheet of milky fire. The light is not only to be seen where the crests of waves are breaking, or the surface disturbed by the bows of the boat, but the phosphorescence extends as far as the eye can reach in all directions. It is impossible, of course, to say with any degree of certainty whether phosphorescence such as this exists at the bottom of the deep sea, but it is quite probable that it does in some places, and hence the well-developed eyes and brilliant colors of some of the deep-sea animals.—HICKSON *Fauna of the Deep Sea*, ch. 2, p. 26. (A., 1894.)

1941. LIGHT OF SUN HAS HEALTHFUL INFLUENCE—*Represses or Destroys Bacteria.*—Light acts as an inhibitory or even germicidal agent. This fact was first established by Downes and Blunt in a memoir to the Royal Society in 1877. They found by exposing cultures to different degrees of sunlight that thus the growth of the culture was partially or entirely prevented, being most damaged by the direct rays of the sun, altho diffuse daylight acted prejudicially. Further, these same investigators proved that of the rays of the spectrum which acted inimically the blue and violet rays acted most bactericidally, next to the blue being the red and orange-red rays. The action of light, they explain, is due to the gradual oxidation which is induced by the sun's rays in the presence of oxygen.—NEWMAN *Bacteria*, ch. 1, p. 24. (G. P. P., 1899.)

1942. LIGHT PASSES UNCHANGED IN QUALITY THROUGH ABYSMAL SPACES—*Spectrum Analysis in Astronomy.*—Spectrum analysis may be shortly described as a mode of distinguishing the various species of matter by the kind of light proceeding from each. This definition at once explains how it is that, unlike every other system of chemical analysis, it has proved available in astronomy. Light, so far as quality is concerned, ignores distance. No intrinsic change, that we yet know of, is produced in it by a journey from the farthest bounds of the visible universe: so that, provided only that in quantity it remain sufficient for the purpose, its peculiarities can be equally well studied whether the source of its vibrations be one foot or a hundred billion miles distant. Now the most obvious distinction between one kind of light and another resides in color. But of this distinction the eye takes cognizance in an esthetic, not in a scientific sense. It finds gladness in the "thousand tints" of Nature.

but can neither analyze nor define them. Here the refracting prism—or the combination of prisms known as the "spectroscope"—comes to its aid, teaching it to measure as well as to perceive.—CLERKE *History of Astronomy*, pt. ii, ch. 1, p. 161. (Bl., 1893.)

1943. LIGHT SIFTED BY NATURAL OBJECTS—*The Color We See Is the Color They Reject.*—Having unraveled the interwoven constituents of white light, we have next to inquire what part the constitution so revealed enables this agent to play in Nature? To it we owe all the phenomena of color, and yet not to it alone; for there must be a certain relationship between the ultimate particles of natural bodies and white light, to enable them to extract from it the luxury of color. But the function of natural bodies is here selective, not creative. There is no color generated by any natural body whatever. Natural bodies have showered upon them, in the white light of the sun, the sum total of all possible colors, and their action is limited to the sifting of that total, the appropriating from it of the colors which really belong to them, and the rejecting of those which do not. It will fix this subject in your minds if I say that it is the portion of light which they reject, and not that which belongs to them, that gives bodies their colors.—TYNDALL *Lectures on Light*, lect. 1, p. 31. (A., 1898.)

1944. LIGHT, TERRESTRIAL, VARIED SOURCES OF—*Phosphorescence of the Ocean.*—As in polar light or the electromagnetic storm, a current of brilliant and often colored light streams through the atmosphere in high latitudes, so also in the torrid zones between the tropics, the ocean simultaneously develops light over a space of many thousand square miles. Here the magical effect of light is owing to the forces of organic Nature. Foaming with light, the eddying waves flash in phosphorescent sparks over the wide expanse of waters, where every scintillation is the vital manifestation of an invisible animal world. So varied are the sources of terrestrial light!—HUMBOLDT *Cosmos*, vol. i, p. 202. (H., 1897.)

1945. LIGHT TRAVERSING PURE WATER—*Undimmed Reflection through Mountain Lake.*—This "gem of the Sierra" [Lake Tahoe] is situated at an elevation of 6,200 feet above the sea, and is enclosed in all directions by rugged, forest-covered mountain slopes which rise from two to over four thousand feet above its surface. Its expanse is unbroken by islands and has an area of between 192 and 195 square miles. . . .

On looking down on Lake Tahoe from the surrounding pine-covered heights, one beholds a vast plain of the most wonderful blue that can be imagined. Near shore, where the bottom is of white sand, the waters have an emerald tint, but are so clear that objects far beneath the surface may be readily distinguished Farther lakeward the tints change by insensible gradation until the water is a deep blue, unrivaled even by the color of the ocean in its deepest and most remote parts. On calm summer days the sky, with its drifting cloud-banks, and the rugged mountains, with their bare and usually snow-covered summits, are mirrored in the placid waters with such wonderful distinctness and such accuracy of detail that one is at a loss to tell where the real ends and the duplicate begins. While floating on the lake in a boat, the transparency of the water gives the sensation that one is suspended in mid-air, as every detail on the bottom, fathoms below, is clearly discernible.

In experimenting on the transparency of the waters, Professor John Le Conte found that a white disk 9.5 inches in diameter, when fastened to a line and lowered beneath the surface, was clearly visible at a depth of 108 feet. It is to be remembered that the light reaching the eye in such an experiment traverses through water twice the distance to which the disk is submerged, or, in the experiment referred to, 216 feet. The only instance in this country in which waters have been found to be more transparent is in the great limestone-water springs of Florida.—RUSSELL *Lakes of North America*, ch. 4, p. 64. (G. & Co., 1895.)

1946. LIGHT, "UNNATURAL," IN SOLAR ECLIPSE—*Hungry Dog Refuses Food—Courtiers of Louis XV.*—I have spoken of the "unnatural" appearance of the light just before totality. This is not due to excited fancy, for there is something so essentially different from the natural darkness of twilight that the brute creation shares the feeling with us. Arago, for instance, mentions that in the eclipse of 1842, at Perpignan, where he was stationed, a dog which had been kept from food twenty-four hours was, to test this, thrown some bread just before "totality" began. The dog seized the loaf, began to devour it ravenously, and then, as the appearance already described came on, he dropped it. The darkness lasted some minutes, but not till the sun came forth again did the poor creature return to the food. It is no wonder, then, that men also, whether educated or ignorant, do not escape the impression. A party of the courtiers of Louis XV. is said to have gathered round Cassini to witness an eclipse from the terrace of the Paris Observatory, and to have been laughing at the populace, whose cries were heard as the light began to fade; when, as the unnatural gloom came quickly on, a sudden silence fell on them too, the panic terror striking through their laughter. Something common to man and the brute speaks at such times, if never before or again; something which is not altogether physical apprehension, but more like the moral dismay when the shock of an earthquake is felt for the first time, and we first know that startling doubt, superior to reason, whether the solid frame of earth is real,

and not " baseless as the fabric of a vision." —LANGLEY *New Astronomy*, ch. 2, p. 41. (H. M. & Co., 1896.)

1947. LIGHT, WAVES OF, ABOLISH EACH OTHER—*Motion of Light Differs from That of Sound.*—On the assumption that light was wave-motion, all his [Thomas Young's] experiments on interference were explained; on the assumption that light was flying particles, nothing was explained. In the time of Huyghens and Euler a medium had been assumed for the transmission of the waves of light; but Newton raised the objection that, if light consisted of the waves of such a medium, shadows could not exist. The waves, he contended, would bend round opaque bodies and produce the motion of light behind them, as sound turns a corner or as waves of water wash round a rock. It was proved that the bending-round referred to by Newton actually occurs, but that the inflected waves abolish each other by their mutual interference. Young also discerned a fundamental difference between the waves of light and those of sound. Could you see the air through which sound-waves are passing, you would observe every individual particle of air oscillating to and fro in the direction of propagation. Could you see the luminiferous ether, you would also find every individual particle making a small excursion to and fro; but here the motion . . . would be across the line of propagation. The vibrations of the air are longitudinal, those of the ether transversal.—TYNDALL *Lectures on Light*, lect. 2, p. 59. (A., 1898.)

1948. LIGHT WHERE SUN'S RAYS NEVER COME—*Rows of Lights on Sides of Deep-sea Fish—The Scopelus.*—We can distinguish two kinds of phosphorescent organs in the deep-sea fish. There are the curious eye-like or ocellar organs situated usually in one or more rows down the sides of the fish's body, forming as it were a series of miniature bull's-eye lanterns to illuminate the surrounding sea, and various glandular organs that may be situated at the extremity of the barbels or in broad patches behind the eyes or in other prominent places on the head and shoulders. Ocellar organs have been known for many years to occur on the sides of the interesting pelagic fish *Scopelus*. Most of the species of this genus live in the open sea at moderate depths, coming to the surface only at night, but other species are found in almost every depth down to 2,000 fathoms of water.—HICKSON *Fauna of the Deep Sea*, ch. 4, p. 77. (A., 1894.)

1949. " LIGHTHOUSE OF THE MEDITERRANEAN " — *The Island Volcano of Stromboli.*—Viewed at night-time, Stromboli presents a far more striking and singular spectacle. The mountain, owing to its great elevation, is visible over an area having a radius of more than 100 miles. When watched from the deck of a vessel anywhere within this area, a glow of red light [caused by the light of internal fires reflected from the overhanging cloud of vapor] is seen to make its appearance from time to time above the summit of the mountain; this glow of light may be observed to increase gradually in intensity, and then as gradually to die away. After a short interval the same appearances are repeated, and this goes on till the increasing light of the dawn causes the phenomenon to be no longer visible. The resemblance presented by Stromboli to a " flashing light " on a most gigantic scale is very striking, and the mountain has long been known as " the lighthouse of the Mediterranean."—JUDD *Volcanoes*, ch. 2, p. 10. (A., 1899.)

1950. LIGHTING, METHODS OF—*Torches Reach Down to Modern Days—Greek and Roman Lamps—The Argand Burner.*—Till this century we used torches much as the ancient Romans did, but they are now seldom to be seen, and by their disuse the picturesque side of life loses many striking effects of torchlight glare and shadow on banquet and procession—the delight of painters and poets. Not half the passers-by in old-fashioned streets now know that the extinguishers on the iron railings were to put out the links or torches carried to light the company to their coaches. The candle looks as tho it might have been invented from the torch. The rushlight, made of the pith of the rush dipped in melted fat, was in common use in Pliny's time, as was also the wax or tallow candle with its yarn wick. The old classic lamp was a flattish oval vessel with a nozle (*i. e.*, nostril) at one end for the wick to come out at. Simple as this construction is, it has had a long unchanged use. Museums have few Greek and Roman objects more plentiful than such earthenware lamps, nor more exquisite specimens of metal-work than the bronze ones; and to this day the traveler off the main road in Spain or Italy is lighted to his bedroom with a brass stand-lamp much after the manner of the ancients, with its pickwick hanging to it by a chain. The lamp only came into its improved modern make about a century ago, when Argand let the air in from below, and put on the glass chimney to set up a draft.—TYLOR *Anthropology*, ch. 11, p. 272. (A., 1899.)

1951. LIGHTNING, PHENOMENA OF—*House Struck by—Sleeper Strangely Preserved.*—Professor Henry . . . stated that he had lately examined a house struck by lightning, which exhibited some effects of an interesting kind. The lightning struck the top of the chimney, passed down the interior of the flue to a point opposite a mass of iron placed on the floor of the garret, where it pierced the chimney; thence it passed explosively (breaking the plaster) into a bedroom below, where it came in contact with a copper bell-wire, and passed along this horizontally and silently for about six feet; thence it leaped explosively through the air

a distance of about ten feet, through a dormer window, breaking the sash, and scattering the fragments across the street. It was evidently attracted to this point by the upper end of a perpendicular gutter, which was near the window. It passed silently down the gutter, exhibiting scarcely any mark of its passage until it arrived at the termination, about a foot from the ground. Here again an explosion appeared to have taken place, since the windows of the cellar were broken. A bed, in which a man was sleeping at the time, was situated against the wall, immediately under the bell-wire; and altho his body was parallel to the wire, and not distant from it more than four feet, he was not only uninjured, but not sensibly affected. The size of the hole in the chimney, and the fact that the lightning passed along the copper wire without melting it, show that the discharge was a small one, and yet the mechanical effects, in breaking the plaster, and projecting the window-frame across the street, were astonishingly great.—HENRY *On the Protection of Houses from Lightning, Scientific Writings*, p. 232. (Sm. Inst., 1886.)

1952. LIKENESS OF EMBRYOS OF DIVERSE BEINGS—*Separation Attendant on Development.*—It has been shown that generally the embryos of the most distinct species belonging to the same class are closely similar, but become, when fully developed, widely dissimilar. A better proof of this latter fact cannot be given than the statement by Von Baer that "the embryos of mammalia, of birds, lizards, and snakes, probably also of *Chelonia*, are in the earliest states exceedingly like one another, both as a whole and in the mode of development of their parts; so much so, in fact, that we can often distinguish the embryos only by their size. In my possession are two little embryos in spirit, whose names I have omitted to attach, and at present I am quite unable to say to what class they belong. They may be lizards or small birds, or very young mammalia, so complete is the similarity in the mode of formation of the head and trunk in these animals. The extremities, however, are still absent in these embryos. But even if they had existed in the earliest stage of their development we should learn nothing, for the feet of lizards and mammals, the wings and feet of birds, no less than the hands and feet of men, all arise from the same fundamental form." [Compare GERMS, 1368-70.]—DARWIN *Origin of Species*, ch. 14, p. 458. (Burt.)

1953. LIKENESS, REMARKABLE, OF ANIMAL AND PLANT—*Digestive Fluid of Sundew Resembles Gastric Juice of Animals—A Common Thought Unites Two Kingdoms.*—The glands of *Drosera* [sundew] absorb matter from living seeds which are injured or killed by the secretion. They likewise absorb matter from pollen and from fresh leaves; and this is notoriously the case with the stomachs of vegetable-feeding animals. *Drosera* is properly an insectivorous plant; but as pollen cannot fail to be often blown on to the glands, as will occasionally the seeds and leaves of surrounding plants, *Drosera* is, to a certain extent, a vegetable feeder. . . . There is a remarkable accordance in the power of digestion between the gastric juice of animals with its pepsin and hydrochloric acid, and the secretion of *Drosera* with its ferment and acid belonging to the acetic series. We can, therefore, hardly doubt that the ferment in both cases is closely similar, if not identically the same. That a plant and an animal should pour forth the same, or nearly the same, complex secretion, adapted for the same purpose of digestion, is a new and wonderful fact in physiology.—DARWIN *Insectivorous Plants*, ch. 6, p. 110. (A., 1900.)

1954. LIMBS, LOST, REMNANTS OF—*Rudimentary Organs—Hind Legs of Serpents and Fishes.*—An abundance of the most interesting examples of rudimentary organs is furnished by comparative osteology, or the study of the skeletons of vertebrate animals, one of the most attractive branches of comparative anatomy. In most of the vertebrate animals we find two pairs of limbs on the body, a pair of fore legs and a pair of hind legs. Very often, however, one or the other pair is imperfect; it is seldom that both are, as in the case of serpents and some varieties of eel-like fish. But some serpents, viz., the giant serpents (boa, python), have still in the hinder portion of the body some useless little bones, which are the remains of lost hind legs. In like manner the mammals of the whale tribe (*Cetacea*), which have only fore legs fully developed (breast fins), have further back in their body another pair of utterly superfluous bones, which are remnants of undeveloped hind legs. The same thing occurs in many genuine fishes, in which the hind legs have in like manner been lost.—HAECKEL *History of Creation*, vol. i, ch. 1, p. 14. (K. P. & Co., 1899.)

1955. LIMESTONE, HILLS OF, ONCE BENEATH SEA—*Historical Antiquity Is Geologically Recent.*—We observe in Sicily a lofty table-land and hills, sometimes rising to the height of 3,000 feet, capped with a limestone, in which from 70 to 85 per cent. of the fossil *Testacea* are specifically identical with those now inhabiting the Mediterranean. These calcareous and other argillaceous strata of the same age are intersected by deep valleys which have been gradually formed by denudation, but have not varied materially in width or depth since Sicily was first colonized by the Greeks. The limestone, moreover, which is of so late a date in geological chronology, was quarried for building those ancient temples of Girgenti and Syracuse of which the ruins carry us back to a remote era in

human history. If we are lost in conjectures when speculating on the ages required to lift up these formations to the height of several thousand feet above the sea, how much more remote must be the era when the same rocks were gradually formed beneath the waters!—LYELL *Principles of Geology*, bk. i, ch. 13, p. 185. (A., 1854.)

1956. LIMIT OF HUMAN POWERS —*Measuring Star Distances—The Earth's Orbit Too Narrow—The Distance of but One Star Fairly Measured.*—To measure star distances the earth's dimensions are altogether too small. No instrument which man will ever make would show the slightest difference in the direction of any star as seen from opposite sides of the earth. But precisely as the measurer of the moon's distance need not leave his observatory, or have a companion observer working at a distant station, if he prefers to trust to the earth's rotation to sway his station from one side to the other—so the astronomer, unable to leave the earth to seek, as he would wish, a station millions of miles away, can nevertheless avail himself of the earth's motion of revolution around the sun, which in the course of six months will carry the earth from one side of her path to the opposite side, one hundred and eighty-three millions of miles away. One place and the other (any two opposite points of the earth's orbit) may be regarded as two observing stations at the ends of a base-line of this enormous length, laid down, as it were, to extend astronomical survey from the solar system to the stars.

It might be thought that this base-line could not but be amply sufficient for the purpose in view. But so much vaster are the distances of the stars that until quite recent years this base-line proved altogether too short for effective measurements, and even now only one star has had its distance fairly measured, while some nine or ten have had their distances roughly estimated. All the rest which have been tried lie so far beyond our means of measurement as to show no signs whatever of change of place as the earth circuits around that orbit which to our conceptions seems so enormous in extent.—PROCTOR *Expanse of Heaven*, p. 241. (L. G. & Co., 1897.)

1957. LIMIT OF "PERPETUAL SNOW"—*Snow-line Highest under the Equator—Southern and Northern Slopes Compared—Silent Victory of Sunshine.*—That temperature is a very important factor in determining the height of that line [the snow-line] is obvious, and hence it follows that as a rule the snow-line is higher the nearer the mountains are to the equator. On the south side of Mont Blanc, in the Alps, the limit of perpetual snow is about 9,000 feet above sea-level, while on the Andes, near the equator, it is situated at about the height of 16,000 feet—higher than the highest summit of the Alps. For the same reason the snow-line is usually higher on the side of a mountain exposed to the sun than on the side turned away from it. It is, for example, about 1,000 feet higher on the south than on the north side of the Alps.—CHISHOLM *Nature-Studies*, p. 34. (Hum., 1888.)

1958. LIMIT OF SENSITIVENESS IN RETINA—*Ready Motion Compensates—Wide Field of Vision Secured.*—An optical defect which has long been known to ophthalmologists—the inferiority in the sensitiveness of the retinal surface generally to that of the central spot known as the *macula lutea*—is shown by Professor Helmholtz to be fully compensated by the facility and rapidity with which we move the eye, in such a manner as to bring the image of the object, or of any part of the object, which we wish to examine minutely, upon this sensitive spot; whilst the field over which our vision ranges with sufficient distinctness to see our special object in combination with its surroundings, is far larger than is attainable in any optical instrument of human contrivance.—CARPENTER *Nature and Man*, lect. 15, p. 423. (A., 1889.)

1959. LIMIT OF THE POWER OF THE MICROSCOPE—*Structure that Defies Microscopic Analysis.*—Have the diamond, the amethyst, and the countless other crystals formed in the laboratories of Nature and of man no structure? Assuredly they have; but what can the microscope make of it? Nothing. It cannot be too distinctly borne in mind that between the microscopic limit and the true molecular limit there is room for infinite permutations and combinations. . . . This first marshaling of the atoms, on which all subsequent action depends, baffles a keener power than that of the microscope. When duly pondered, the complexity of the problem raises the doubt, not of the power of our instrument, for that is *nil*, but whether we ourselves possess the intellectual elements which will ever enable us to grapple with the ultimate structural energies of Nature.—TYNDALL *Fragments of Science*, vol. ii, ch. 8, p. 125. (A., 1897.)

1960. LIMIT OF VISUAL FIELD CONCENTRATES ATTENTION—*Practical Perfection of the Eye.*—Now while the disadvantage of the limitation of distinct vision to the *macula lutea* [the sensitive spot of the retina] is thus fully compensated, I hold that this limitation is positively advantageous in this way—that we see the object, or the part of the object, at which we will to look with much greater distinctness than we should do if the whole of the visual picture which we receive at one time were as complete and vivid as that portion of it which is formed on the central spot of the retina. For our mental receptivity of this picture depends upon the attention we give it; so that the more completely our attention is concentrated upon the thing at which we specially wish to look, the more distinctly we see it. The micro-

scopist well knows the great advantage of limiting his field of view when he is examining objects of the greatest difficulty. And every one who has been accustomed to visit picture-galleries is aware how much more fully he is able to appreciate a picture when he looks at it in such a manner that its surroundings are kept out of his view.

To be able to bring our fullest measure of visual power to bear upon any object we desire to examine, and at the same time to see surrounding objects with sufficient distinctness for the recognition of their local relation to it, is, thus, far more advantageous to us than would be the extension of that highest degree of visual power over the whole range at once. Here again, therefore, the asserted imperfection of the eye as an optical instrument proves to be the very contrary, when its structure and action are regarded in their relations to the use we make of the organ, added force being thus given to the final conclusion drawn by Professor Helmholtz that "the adaptation of the eye to its function is most complete, and is seen in the very limits which are set in its defects." Those who quote his previous statement, for the purpose of depreciating the perfection of the organ, are bound in honesty to cite this also.—CARPENTER *Nature and Man*, lect. 15, p. 426. (A., 1889.)

1961. LIMITATION, LAW OF—*Absolute Satisfaction Possible.*—We feel our own ignorance and our own helplessness, not because we have reached, but because we cannot reach, the limits of our intellectual powers, and because the desires which correspond to them are consequently left unsatisfied. This is the difference between ourselves and the lower animals. We can perfectly understand the absolute limitations under which they lie, because in many of our lower faculties we share these limitations with the beasts. All their powers and many of our own are exerted without any sense of limitation, and this because of the very fact that the limitation of them is absolute and complete. In their own nature they admit of no larger use. The field of effort and of attainable enjoyment is, as regards them, coextensive with the whole field in view. Nothing is seen, or felt, or wished for by them which may not be possessed. In such possession all exertion ends and all desire is satisfied. This is the law of every faculty subject to a limit which is absolute; and where this law does not apply, there we may be sure that the limitation is not absolute, but conditional.—ARGYLL *Unity of Nature*, ch. 4, p. 77. (Burt.)

1962. LIMITATION OF IMPULSE AND MOVEMENT—*Fatigue Diminished by Habit.*—The first result of habit is that it simplifies the movements required to achieve a given result, makes them more accurate, and diminishes fatigue.

"The beginner at the piano not only moves his finger up and down in order to depress the key, he moves the whole hand, the forearm, and even the entire body, especially moving its least rigid part, the head, as if he would press down the key with that organ too. Often a contraction of the abdominal muscles occurs as well. Principally, however, the impulse is determined to the motion of the hand and of the single finger. This is, in the first place, because the movement of the finger is the movement *thought of*, and, in the second place, because its movement and that of the key are the movements we try to *perceive*, along with the results of the latter on the ear. The more often the process is repeated, the more easily the movement follows, on account of the increase in permeability of the nerves engaged. But the more easily the movement occurs, the slighter is the stimulus required to set it up; and the slighter the stimulus is, the more its effect is confined to the fingers alone. Thus, an impulse which originally spread its effects over the whole body, or at least over many of its movable parts, is gradually determined to a single definite organ, in which it effects the contraction of a few limited muscles. In this change the thoughts and perceptions which start the impulse acquire more and more intimate causal relations with a particular group of motor nerves."—SCHNEIDER *Der menschliche Wille*, quoted by JAMES in *Psychology*, vol. i, ch. 4, p. 112. (H. H. & Co., 1899.)

1963. LIMITS, FIXED, OF NATURAL SCIENCE—*Ultimate Entities beyond Human Knowledge.*—Natural philosophy has a fixed boundary that she is not permitted to step across. It must be continually remembered in spite of all discoveries that such things as light, electricity, and magnetism cannot be brought into experience because the human intellect has nothing but a representation of things that possess materiality.—LIEBIG *Thierchemie*, p. 8. (Translated for *Scientific Side-Lights.*)

1964. LIMITS OF HUMAN KNOWLEDGE—*Chemistry Stops at Elements—No Human Discovery Goes Beyond.*—When we attempt to break up the various materials around us into simpler parts we soon reach a class of substances which cannot be further decomposed. Simple inspection will show that granite rock, for example, is a mixture of three minerals, called feldspar, mica, and quartz. We know, also, that feldspar consists of alumina, potash, and silica; that mica contains the same materials in different proportions, and that quartz is silica alone. Lastly, the chemists have discovered that alumina is composed of aluminum and oxygen, potash of potassium and oxygen, and silica of silicon and oxygen. But here we must stop; for when you ask us of what these last-named materials are made we find ourselves in the condition of the old philosopher, who got on very well with his flat earth, supporting it on an elephant, and the

elephant on a tortoise, until he came to seek a resting-place for the tortoise; but then his theory failed. So is it with our science. These undecomposed materials are the blocks on which the whole is built, and we are totally ignorant of what lies below. We call all substances which have never yet been decomposed, whatever may be their nature, chemical elements, and of such some seventy are now known.—COOKE *Religion and Chemistry*, ch. 3, p. 86. (A., 1897.)

1965. ——— ——— *Differences Unrecognized—Embryonic Cells Not Identical in Structure.*—When we are told that a moner or an embryo-cell is the early stage of all animals alike, we naturally ask, Is it meant that all these cells are really similar, or is it only that they appear similar to us, and may actually be as profoundly unlike as the animals which they are destined to produce? . . . There is, indeed, the best ground to suppose that the one-celled animals and the embryo-cells referred to have little in common except their general form. We know that the most minute cell must include a sufficient number of molecules of protoplasm to admit of great varieties of possible arrangement, and that these may be connected with most varied possibilities as to the action of forces. Further, the embryo-cell which is produced by a particular kind of animal, and whose development results in the reproduction of a similar animal, must contain potentially the parts and structures which are evolved from it; and fact shows that this may be affirmed of both the embryo- and the sperm-cells where there are two sexes. Therefore it is in the highest degree probable that the eggs of a worm and those of man, tho possibly alike to our coarse methods of investigation, are as dissimilar as the animals that result from them.—DAWSON *Facts and Fancies in Modern Science*, lect. 1, p. 76. (A. B. P. S.)

1966. ——— ——— *Interior of Our Own Earth Unknown—Trivial Explorations.*—In entering upon any speculations or inquiries concerning the nature of the interior of our globe it is necessary before all things that we should clearly realize in our minds how small and almost infinitesimal is that part of the earth's mass which can be subjected to direct examination. The distance from the surface to the center of our globe is nearly 4,000 miles, but the deepest mines do not penetrate to much more than half a mile from the surface, and the deepest borings fall far short of a mile in depth.—JUDD *Volcanoes*, ch. 11, p. 307. (A., 1899.)

1967. ——— ——— *Memory an Ultimate Fact of Consciousness—Science Has No Explanation.*—When, for instance, I recall my graduation-day, and drag all its incidents and emotions up from death's dateless night, no mechanical cause can explain this process, nor can any analysis reduce it to lower terms or make its nature seem other than an ultimate datum, which, whether we rebel or not at its mysteriousness, must simply be taken for granted if we are to psychologize at all. However the associationist may represent the present ideas as thronging and arranging themselves, still, the spiritualist insists, he has in the end to admit that *something*, be it brain, be it "ideas," be it "association," *knows* past time *as* past, and fills it out with this or that event. And when the spiritualist calls memory an "irreducible faculty" he says no more than this admission of the associationist already grants.—JAMES *Psychology*, vol. i, ch. 1, p. 2. (H. H. & Co., 1899.)

1968. ——— ——— *Science Must Leave Some Transcendent Problems Unsolved—Great Value of the Saying, "I Don't Know."*—The astronomer has no choice but to deal with the evidence supplied to him. It would be very convenient if he would invent evidence, and he might in this way give a much more striking and satisfactory account of the mysteries of the star depths. But what we want is the truth; and the truthful astronomer must often be content to give that answer which was the favorite reply, we are told, of the eminent French mathematician, Lagrange, "I don't know."

I remember how on one occasion I was asked, at the close of a lecture on the star depths, why I had not told my audience the true shape of the sidereal universe—that is, its relative length, breadth, and depth. I replied in effect that before I could give this information I must first possess it myself, and that as yet no man possessed it. I could perceive that the audience were very far from satisfied with this reply. But I might have occasioned even more dissatisfaction if I had said, what is in all probability the real truth, that not only is man now ignorant of the configuration of the sidereal universe, but he can never hope to attain exact knowledge on the subject.—PROCTOR *Expanse of Heaven*, p. 80. (L. G. & Co., 1897.)

1969. LIMITS OF HUMAN PERCEPTION HIDE CELESTIAL GLORY—*Saturn as Revealed by Telescope.*—We turn on Saturn a powerful telescope on some calm, clear night, when the air is well suited for observation, and we see the most beautiful picture conceivable—a glorious orb, the surface resplendent with the most beautiful colors, blue at the poles, yellow elsewhere, crossed by a creamy white central belt, and flecked with spots which under favorable circumstances show brown, and purple, and ruddy tints. The most wonderful part of the picture, however, is the amazing ring-system, not a mere ring, as it is so often shown, but a complex system of rings, each curiously variegated in color, while the innermost (richly purple under favorable observing conditions) is unique among celestial objects in being transparent, so that

the orb of the planet can be seen through this "crape-veil ring," as astronomers have called it.—PROCTOR *Expanse of Heaven*, p. 94. (L. G. & Co., 1897.)

1970. LIMITS OF HUMAN THOUGHT—*Infinite Minuteness and Infinite Vastness Baffle.*—What notion can you form of the magnitude of such particles [the ultimate particles of matter]? The distances of stellar space give us simply a bewildering sense of vastness, without leaving any distinct impression on the mind; and the magnitudes with which we have here to do bewilder us equally in the opposite direction. We are dealing with infinitesimals, compared with which the test-objects of the microscope are literally immense.—TYNDALL *Fragments of Science*, vol. ii, ch. 8, p. 122. (A., 1897.)

1971. ——— ——— *The Infinity of Space.*—We cannot think of space as finite, for wherever in imagination we erect a boundary we are compelled to think of space as existing beyond it. Thus by the incessant dissolution of limits we arrive at a more or less adequate idea of the infinity of space.—TYNDALL *Fragments of Science*, vol. i, ch. 1, p. 3. (A., 1897.)

1972. ——— ——— *The Universe Unsolved.*—I compare the mind of man to a musical instrument with a certain range of notes, beyond which in both directions exists infinite silence. The phenomena of matter and force come within our intellectual range; but behind, and above, and around us the real mystery of the universe lies unsolved, and, as far as we are concerned, is incapable of solution.—TYNDALL *Fragments of Science*, vol. ii, ch. 15, p. 393. (A., 1900.)

1973. LIMITS OF PHYSICAL SCIENCE—*Never Satisfies Soul.*—Lange considers the relation of Epicurus to the gods subjective; the indication, probably, of an ethical requirement of his own nature. We cannot read history with open eyes or study human nature to its depths, and fail to discern such a requirement. Man never has been and he never will be satisfied with the operations and products of the understanding alone; hence physical science cannot cover all the demands of his nature.—TYNDALL *Fragments of Science*, vol. ii, ch. 9, p. 141. (A., 1897.)

1974. LIMITS OF THE DOCTRINE OF EVOLUTION—Facts of this kind [permanence of various species from geologic times] are undoubtedly fatal to any form of the doctrine of evolution which postulates the supposition that there is an intrinsic necessity, on the part of animal forms which have once come into existence, to undergo continual modification; and they are as distinctly opposed to any view which involves the belief that such modification as may occur must take place at the same rate in all the different types of animal or vegetable life. The facts, as I have placed them before you, obviously directly contradict any form of the hypothesis of evolution which stands in need of these two postulates.—HUXLEY *American Addresses*, lect. ii, p. 38. (A., 1898.)

1975. LIMITS TO EDUCATIONAL USE OF SCIENTIFIC THEORIES—I have never advocated the introduction of the theory of evolution into our schools. I should even be disposed to resist its introduction before its meaning had been better understood and its utility more fully recognized than it is now by the great body of the community. The theory ought, I think, to bide its time until the free conflict of discovery, argument, and opinion has won for it this recognition.—TYNDALL *Fragments of Science*, vol. ii, ch. 15, p. 399. (A., 1900.)

1976. LIMITS TO MAGNIFYING POWER OF TELESCOPE—The exceedingly high magnifying powers employed by Herschel constituted a novelty in optical astronomy to which he attached great importance. Yet the work of ordinary observation would be hindered rather than helped by them. The attempt to increase in this manner the efficacy of the telescope is speedily checked by atmospheric, to say nothing of other difficulties. Precisely in the same proportion as an object is magnified, the disturbances of the medium through which it is seen are magnified also. Even on the clearest and most tranquil nights the air is never for a moment really still. The rays of light traversing it are continually broken by minute fluctuations of refractive power caused by changes of temperature and pressure, and the currents which these engender. With such luminous quiverings and waverings the astronomer has always more or less to reckon; their absence is simply a question of degree; if sufficiently magnified, they are at all times capable of rendering observation impossible.—CLERKE *History of Astronomy*, pt. i, ch. 6, p. 137. (Bl., 1893.)

1977. LINKS BETWEEN EUROPEAN AND AMERICAN SPECIES—*Bison and Bear in New and Old World.*—If species were in reality unconnected by common ancestors, then it would necessarily follow that, as our knowledge of any group increased, the separations between the different species would become more and more unmistakable. On the contrary, however, it is a well-known fact that the difficult genera become still more difficult as they are more profoundly studied. If, indeed, we consider existing forms only, no doubt the distinctions between the greater number of species are well marked, nor does any one expect to find a living series of links between them. The intermediate forms lived in Tertiary and Quaternary times. Thus, directly we commence to study the extinct forms, all the convenient lines of separation gradually thin out. . . . To take only two cases from the group of Quaternary mammalia, . . . the European and American bisons,

which are now quite distinct, are connected by the *Bison priscus*, while between our brown bear and the grizzly bear of the Rocky Mountains a series of links has been discovered among the abundant remains in the bone-caves.—AVEBURY *Prehistoric Times*, ch. 9, p. 289. (A., 1900.)

1978. LISBON, EARTHQUAKE OF—*Sixty Thousand Persons Perish in Six Minutes.*—In no part of the volcanic region of southern Europe has so tremendous an earthquake occurred in modern times as that which began on the 1st of November, 1755, at Lisbon. A sound of thunder was heard underground, and immediately afterwards a violent shock threw down the greater part of that city. In the course of about six minutes sixty thousand persons perished. The sea first retired and laid the bar dry; it then rolled in, rising fifty feet or more above its ordinary level. The mountains of Arrabida, Estrella, Julio, Marvan, and Cintra, being some of the largest in Portugal, were impetuously shaken, as it were, from their very foundations; and some of them opened at their summits, which were split and rent in a wonderful manner, huge masses of them being thrown down into the subjacent valleys. Flames are related to have issued from these mountains, which are supposed to have been electric; they are also said to have smoked, but vast clouds of dust may have given rise to this appearance.—LYELL *Principles of Geology*, bk. ii, ch. 29, p. 495. (A., 1854.)

1979. LOCATION OF OBJECTS IN SPACE—*Due to Joint Action of the Two Eyes.*—With the reference of objects to different distances in space, the world of perception is placed outside of us, and is differentiated into an infinite diversity of content. Altho the spatial relations which we ascribe to external objects may at the outset often be incomplete and deceptive, still the decisive step has been taken with the very introduction of those relations. The ceaseless activity of our sense-perception is constantly at work in the endeavor to perfect our ideas. It furnishes us with new ideational groups, and corrects the most serious errors in those already acquired. All the senses cooperate in this work, each revising and supplementing the others. But it is primarily the common action of the two coordinate organs of vision to which we owe the greatest part of our ideational development. There are no other organs which so directly supplement and correct each other's perceptions, and which thus give so great an impulse to the fusion of separate perceptions into a single idea, as the two eyes.—WUNDT *Psychology*, lect. 12, p. 181. (Son. & Co., 1896.)

1980. LOCKJAW, OR TETANUS, IN GRASP OF SCIENCE—*Infection, Insignificant, Producing Terrible Result—Cure by Opposing Evil in Its Stronghold.*—Tetanus occurs in man and horses most commonly, tho it may affect other animals. There is usually a wound, often an insignificant one, which may occur in any part of the body. The popular idea that a severe cut between the thumb and the index-finger leads to tetanus is without scientific foundation. As a matter of fact, the wound is nearly always on one or other of the limbs, and is infected simply because they come more into contact with soil and dust than does the trunk. It is not the locality of the wound nor its size that affects the disease. A cut with a dirty knife, a gash in the foot from the prong of a gardener's fork, the bite of an insect, or even the prick of a thorn has before now set up tetanus. Wounds which are jagged, and occurring in absorptive tissues, are those most fitted to allow the entrance of the bacillus. The wound forms a local manufactory, so to speak, of the bacillus and its secreted poisons; the bacillus always remains in the wound, but the toxins may pass throughout the body, and are especially absorbed by the cells of the central nervous system, and thus give rise to the spasms which characterize the disease. . . . Evidence has recently been forthcoming at the Pasteur Institute to support the theory that tetanus is a nervous disease, more or less allied to rabies, and is best treated by intracerebral injections of antitoxin, which then has an opportunity of opposing the toxins at their favorite site.—NEWMAN *Bacteria*, ch. 5, p. 168. (G. P. P., 1899.)

1981. LOCOMOTION, PRIMITIVE—*Men as Carriers—First Carriage in England—First Stage-coaches.*—In all previous ages the only modes of traveling or of conveying goods for long distances were by employing either men or animals as the carriers. Wherever the latter were not used all loads had to be carried by men, as is still the case over a large part of Africa, and as was the case over almost the whole of America before its discovery by the Spaniards.

But throughout Europe and Asia the horse was domesticated in very early times, and was used for riding and in drawing war chariots; and throughout the Middle Ages packhorses were in universal use for carrying various kinds of goods and produce, and saddle-horses for riding. All journeys were then made on horseback, and it was in comparatively recent times that wheeled vehicles for traveling in came into general use in England. The very first carriage was made for Queen Elizabeth in 1568; the first that plied for hire in London were in 1625, and the first stage-coaches in 1659.—WALLACE *The Wonderful Century*, ch. 1, p. 5. (D. M. & Co., 1899.)

1982. LOGIC AND SCIENCE—*Invariability of Natural Law.*—There are scientific men who assert that the interposition of Providence is impossible and prayer an absurdity, because the laws of Nature are proved invariable. Inferences are drawn not so much from particular sciences as from

the logical nature of science itself. Now I may state that my own studies in logic lead me to call in question such negative inferences. Laws of Nature are uniformities observed to exist in the action of certain material agents, but it is logically impossible to show that all other agents must behave as they do.—JEVONS quoted by STUCKENBERG *Int. to the Study of Philosophy*, p. 403. (A. & S., 1892.)

1983. LOGIC NO GUARANTY OF TRUTH—That a conclusion is deduced by the strictest logical method from an uncertain premise does not give it a hair's breadth of certainty or of value.—HELMHOLTZ *Popular Lectures*, lect. 5, p. 213. (L. G. & Co., 1898.)

1984. LOGIC OF PLAY—*Founds on Native Impulses.*—The impulse to play in special ways is certainly instinctive. . . . All simple active games are attempts to gain the excitement yielded by certain primitive instincts, through feigning that the occasions for their exercise are there. They involve imitation hunting, fighting, rivalry, acquisitiveness, and construction, combined in various ways; their special rules are habits, discovered by accident, selected by intelligence, and propagated by tradition; but unless they were founded in automatic impulses, games would lose most of their zest.—JAMES *Psychology*, vol. ii, ch. 24, p. 427. (H. H. & Co., 1899.)

1985. LONELINESS, DELIGHT IN—*Larger Fellowship with Universe.*—I was soon upon the ice, once more alone, as I delight to be at times. As a habit going alone is to be deprecated, but sparingly indulged in it is a great luxury. There are no doubt moods when the mother is glad to get rid of her offspring, the wife of her husband, the lover of his mistress, and when it is not well to keep them together. And so, at rare intervals, it is good for the soul to feel the full influence of that "society where none intrudes." When the work is clearly within your power, when long practise has enabled you to trust your own eye and judgment in unraveling crevasses, and your own ax and arm in subduing their more serious difficulties, it is an entirely new experience to be alone amid those sublime scenes. The peaks wear a more solemn aspect, the sun shines with a more effectual fire, the blue of heaven is more deep and awful, and the hard heart of man is often made as tender as a child's. You contract a closer friendship for the universe in virtue of your more intimate contact with its parts.—TYNDALL *Hours of Exercise in the Alps*, ch. 10, p. 116. (A., 1898.)

1986. LONGEVITY AMONG THE JEWS—*Relatively Slight Infant Mortality*—The duration of life among the Israelites is notably much greater than that among Christians. Even in infancy the mortality of the first is relatively less than that of the latter. In the county of Wieselburg, where observations were made for twenty-three years, the mortality during the first year of life was as follows:

Among	1,000 Jewish children	41	deaths
"	1,000 German "	123	"
"	1,000 Hungarian "	167	"
"	1,000 Croatian "	146.9	"

The age of twenty is attained:

By 520.0 Jews in a thousand.
" 513.0 Germans in Altenburg.
" 445.8 Hungarians in Mether.
" 395.4 Croats in Galtendorf.

According to these results, the average life for the Israelites is 46.5 years, for the Germans 26.7, for the Croats 20.2; for the Hungarians the absence of statistics of birth prevents an estimate. For Austria the average age is 27.5.—GALTERS *Die Lebens-Chancen der Israeliten gegenüber den christlichen Confessionen: biostatische Studien (Vierteljahrsschrift für die praktische Heilkunde, Band ii*, p. 19). (Translated for *Scientific Side-Lights.*)

1987. LONGEVITY A RESULT OF ADVANCED CIVILIZATION—*Science Lengthens Human Life.*—Systems of philosophy and forms of religion find a measure of their influence on humanity in census returns. . . . As Dr. Jarvis, in his report to the Massachusetts Board of Health, has stated, at the epoch of the Reformation, "the average longevity in Geneva was 21.21 years; between 1814 and 1833 it was 40.68; as large a number of persons now live to seventy years as lived to forty three hundred years ago. In 1693 the British Government borrowed money by selling annuities on lives from infancy upward, on the basis of the average longevity. The contract was profitable. Ninety-seven years later another tontine, or scale of annuities, on the basis of the same expectation of life as in the previous century, was issued. These latter annuitants, however, lived so much longer than their predecessors that it proved to be a very costly loan for the government. It was found that while ten thousand of each sex in the first tontine died under the age of twenty-eight, only five thousand seven hundred and seventy-two males and six thousand four hundred and sixteen females in the second tontine died at the same age one hundred years later."—DRAPER *Conflict between Religion and Science.* (A., 1875.)

1988. LOSS, APPARENT, OF NITROGEN—*Bacteria Restore It to the Soil.*—In the ordinary processes of vegetation there is a gradual draining of the soil and a passing of nitrogen into the sea; the products of decomposition pass from the soil by this drainage, and are "lost" as far as the soil is concerned. Many of the methods of sewage-disposal are in reality depriving the land of the return of nitrogen which is its necessity. Again, nitrogen is freed in explosions of gunpowder, nitroglycerin, and dynamite, for whatever purpose they are used. Hence the great putrefactive "loss" of nitrogen,

with its subsidiary losses, contributes to reduce this essential element of all life; and if there were no method of bringing it back again to the soil it would seem that plant-life, and therefore animal-life, would speedily terminate.

It is at this juncture, and to perform this vital function, that the nitrogen-fixing [nitrifying] bacteria play their wonderful part: they bring back the free nitrogen and fix it in the soil.—Newman *Bacteria*, ch. 5, p. 160. (G. P. P., 1899.)

1989. LOSS NOT EASILY REPAIRED —*Removal of Earth's Vegetable Covering—Deserts May Remain Desolate for Ages.*—The origin of this absence of plants over large tracts of land, in regions characterized on every side by the most exuberant vegetation, is a geological phenomenon which has hitherto received but little attention; it undoubtedly arises from former revolutions of Nature, such as inundations, or from volcanic convulsions of the earth's surface. When once a region loses its vegetable covering, if the sand is loose and devoid of springs, and if vertically ascending currents of heated air prevent the precipitation of vapor, thousands of years may elapse before organic life can penetrate from the green shores to the interior of the dreary waste.—Humboldt *Views of Nature*, p. 216. (Bell, 1896.)

1990. LOSS OF PRIMITIVE SIMPLICITY—*Civilization Not an Unmixed Gain —Womanly Arts Not Improved.*—There ought to be no doubt that in every case where the savage was fortunate enough to obtain the knife, his carving and whittling were better done. There is a marvelous difference between carving, on the one hand, man's work chiefly, and basketry or pottery, on the other, conservative woman's work. In no tribes were the two last-named arts bettered by contact with the higher race. The work was done with the hands almost wholly. The tools were of the simplest character. The harsh iron awl was not so good as the smooth-pointed bone awl, of which hundreds have been found, and the pride in personal endeavor departed with the quenching of the tribal spirit. The potter's wheel, such as it was three centuries ago, was only a barrier to the unmechanical sex. Therefore those who constantly assert that prejudice made it impossible for the savage to better himself in the adoption of the white man's devices catch only half a truth.—Mason *The Man's Knife among the North American Indians (Report of the U. S. National Museum for 1897*, p. 727).

1991. LOSS THROUGH DISUSE—*Atrophy of Optic Nerve—The Mole Has True Eyes.*—This animal [the mole], whose peculiar habits are known to every one, has true eyes, from which none of the essential parts of the eyes of the Vertebrata are absent, altho these parts are all of the simplest, almost of embryonic structure. The whole eye is very small, deeply embedded in muscles, and quite covered by the skin, so that it is quite invisible externally. The lens consists of a very small number of minute and little altered embryonic cells; the retina, in the same way, is much simpler than in the eyes of other Vertebrata. True degeneration, then, such as makes the eye incapable of seeing, has not taken place; nevertheless the eye of the mole is reduced to almost total inefficiency even when by chance it has an opportunity for using it. This almost total blindness in the mole is the result solely of complete degeneration of the optic nerve, so that the images which are probably formed in the eye itself can never be transmitted to the animal's consciousness. Occasionally, however, the mole even can see a little, for it has been found that both optic nerves are not always degenerate in the same individual, so that one eye may remain in communication with the brain while the other has no connection with it. In the embryo of the mole, however, and without exception, both eyes are originally connected with the brain by well-developed optic nerves, and so theoretically efficient. This may indeed be regarded as a perfectly conclusive proof that the blind mole is descended from progenitors that could see; it would seem, too, to prove that the blindness of the fully grown animal is the result, not of inheritance, but of the directly injurious effects of darkness on the optic nerve in each individual.—Semper *Animal Life*, ch. 3, p. 79. (A., 1881.)

1992. ———— *Atrophy of Wings of Great Auk.*—One of the characteristic water-birds of our North Atlantic coasts is the razor-billed auk. . . . During the winter it migrates southward as far as Long Island. Flight is therefore a necessary faculty, and we find the bird with well-developed wings, which it uses effectively. We can, however, imagine conditions under which it would not be necessary for the razor-bill to fly. It might become a permanent resident of isolated islands, laying its egg on accessible beaches. Already an expert diver, obtaining its food in the water, it would not be obliged to rise into the air, and, as a result of disuse, the wings would finally become too small to support it in aerial flight, tho fully answering the purpose of oars. Apparently this is what has happened in the case of the razor-billed auk's relative, the flightless, extinct great auk. The razor-bill is sixteen inches long and its wing measures eight inches, while the great auk, with a length of thirty inches, has a wing only five and three-fourths inches in length. Aside from this difference in measurements these birds closely resemble each other. So far as we are familiar with the great auk's habits, they agreed with those of the hypothetical case I have just mentioned, and we are warranted, I think,

in assuming that the bird lost the power of flight through disuse of its wings.—CHAPMAN *Bird-Life*, ch. 2, p. 20. (A., 1900.)

1993. ——— ——— *Magnet Must Work or Perish—Man Made for Usefulness.*—If made of the best of steel for the purpose, and hardened and tempered in just the right way, [the magnet] will hold its charge if it is given something to do. If a piece of iron is placed across its poles it also becomes a magnet, and its molecules turn and work in harmony with those of the mother-magnet. These magnetic lines of force reach around in a circuit. Even before the iron, or "keeper," as it is called, is put across its poles there are lines of force reaching around through the air or ether from one pole to another. . . . As long as we give our magnet something to do, up to the measure of its capacity, it will keep up its power. We may make other magnets with it—thousands, yea, millions of them—and it not only does not lose its power, but may be even stronger for having done this work. If, however, we hang it up without its "keeper," and give it nothing to do, it gradually returns to its natural condition in the home circle of molecular rings. Little by little the coercive force is overcome by the constant tendency of the molecule to go back to its natural position among its fellows.

The magnet furnishes many beautiful lessons, as indeed do all the natural phenomena. Every man has within him a latent power that needs only to be aroused and directed in the right way to make his influence felt upon his fellows. Like the magnet, the man who uses his power to help his fellows up to the measure of his limitations not only has been a benefactor to his race, but is himself a stronger and better man for having done so. But, again, like the magnet, if he allows these God-given powers to lie still and rust for want of legitimate use he gradually loses the power he had and becomes simply a moving thing without influence or use in a world in which he vegetates.—ELISHA GRAY *Nature's Miracles*, vol. iii, ch. 4, p. 30. (F. H. & H., 1900.)

1994. ——— ——— *Parasites among Plants.*—Among a number of plants the power of self-assimilation has been entirely lost. They develop no green leaves, but have the peculiarity of penetrating the roots and the main stalk of other plants with their rootlets, of intergrowing with them completely, and of employing for themselves the combinations of carbon prepared by other plants for their own use.—ENGLER *Ueber das Pflanzenleben unter der Erde.* (Translated for *Scientific Side Lights.*)

1995. LOVE CONVERTS PAIN TO JOY—*Any Strong Emotion Makes Man Insensible to Pain.*—It is as truly our nature not to feel pain from the ordinarily painful things at some times as it is to feel them painful at others. In this respect, the power of love to take away pain is not peculiar. Love, when it is strong, can banish pain; but in this it is only like all strong emotions: it is peculiar in its power of making what is ordinarily painful a source of joy, and this a joy of the highest and most exquisite kind. We all know this. We not only are willing, we rejoice, to bear an ordinarily painful thing for the benefit or pleasure of one whom we intensely love. Within certain limits, indeed, but still most truly, the bearing pain for such an end is a privilege to be sought, not a sorrow to be shunned. Universal experience proves this: it is one of the broad, familiar features of human life.—HINTON *The Mystery of Pain*, p. 20. (Hum., 1893.)

1996. LOVE NOT A PRODUCT OF SEX OR MARRIAGE—*Loveless Wedlock among Savages—The Child Awakened Love—United Parents.*—With all [other] barriers removed it might now be supposed that the process was at last complete. But one of the surprises of evolution here awaits us. All the arrangements are finished to fan the flame of love, yet out of none of them was love itself begotten. The idea that the existence of sex accounts for the existence of love is untrue. Marriage among early races . . . has nothing to do with love. Among savage peoples the phenomenon everywhere confronts us of wedded life without a grain of love. Love, then, is no necessary ingredient of the sex relation; it is not an outgrowth of passion. Love is love, and has always been love, and has never been anything lower. Whence, then, came it? If neither the husband nor the wife bestowed this gift upon the world, who did? It was a little child. Till this appeared, man's affection was non-existent; woman's was frozen. The man did not love the woman; the woman did not love the man. But one day from its mother's very heart, from a shrine which her husband never visited nor knew was there, which she herself dared scarce acknowledge, a child drew forth the first fresh bud of a love which was not passion, a love which was not selfish, a love which was an incense from its Maker, and whose fragrance from that hour went forth to sanctify the world. Later, long later, through the same tiny and unconscious intermediary, the father's soul was touched. And one day, in the love of a little child, father and mother met.—DRUMMOND *Ascent of Man*, ch. 9, p. 305. (J. P., 1900.)

1997. LOVE, THE MOTHER'S, UNRIVALED—The passionate devotion of a mother—ill herself, perhaps—to a sick or dying child is perhaps the most simply beautiful moral spectacle that human life affords. Contemning every danger, triumphing over every difficulty, outlasting all fatigue, woman's love is here invincibly su-

perior to anything that man can show.—JAMES *Psychology*, vol. ii, ch. 24, p. 440. (H. H. & Co., 1899.)

1998. LUXURIANCE OF NATURE—*Rapid Growth of Coral.*—The reefs on which these corals grow are very irregular in form, are full of cavities, and have not a solid flat surface of dead rock, like that surrounding the lagoon; nor can they be nearly so hard, for the inhabitants by the aid of crowbars made a channel of considerable length through these reefs, in which a schooner, built on the southeast islet, was floated out. It is a very interesting circumstance that this channel, altho made less than ten years before our visit, was then, as we saw, almost choked up with living coral, so that fresh excavations would be absolutely necessary to allow another vessel to pass through it.—DARWIN *Coral Reefs*, ch. 1, p. 19. (A., 1900.)

1999. LUXURIANCE OF TROPICS—*Forest Superimposed on Forest.*—There seems to be no forest region in the world comparable with that of Brazil; for the dreary one of Africa, described by Stanley, appears far inferior in the development of its trees. But in Brazil, as Alfred Wallace has so graphically described, forest is fitted to and superimposed on forest. At a great height a waving sea of verdure, rich with animal life, is spread out in the dazzling sunshine, borne up on columns which tower through the obscurity of the vast space beneath, wherein a second growth of what would elsewhere seem noble trees finds a congenial home. Beneath these, again, there may yet be another similar but smaller growth, while lycopods and a multitude of humbler herbs clothe the soil.—MIVART *Types of Animal Life*, ch. 1, p. 3. (L. B. & Co., 1893.)

2000. LUXURY A CAUSE OF DEGENERACY—When a bird which has been accustomed to seek its food in trees and bushes finds upon the ground supplies so rich as to afford better sustenance, it will gradually come to live more and more upon the ground, and less and less in trees, a fact which taken alone will entirely alter the conditions of its life. It will not require to fly, and will consequently fly less and less often, and after the lapse of generations will cease to fly altogether. And to bring all this about, the wood in which it lives, the climate, the surrounding animals, need not have undergone any changes; merely the adoption of a new habit by the bird itself will suffice.—WEISMANN *Heredity*, vol. ii, p. 4. (Cl. P., 1892.)

2001. MACHINE DISTRIBUTES ENERGY—*The Coiled Spring.*—Another form of stored energy is manifested in the winding up of a weight or spring; the amount of power that has been expended in winding up the weight may be utilized in its descent when released to drive machinery, as of a clock, and perform various kinds of work. The function of a machine, and its only function, is to distribute energy that has been stored, in a manner that will be most convenient for our purposes.—ELISHA GRAY *Nature's Miracles*, vol. ii, ch. 2, p. 22. (F. H. & H., 1900.)

2002. MACHINE HAS NO INHERENT POWER—*A Product of Mind, but External and Objective.*—[The] essential element in our idea of a machine is that its powers, whatever they may be, are derived, and not original. There may be great knowledge in the work done by a machine, but the knowledge is not in it. There may be great skill, but the skill is not in it; great foresight, but the foresight is not in it; in short, great exhibition of all the powers of mind, but the mind is not in the machine itself. Whatever it does is done in virtue of its construction, which construction is due to a mind which has designed it for the exhibition of certain powers and the performance of certain functions. These may be very simple or they may be very complicated; but whether simple or complicated, the whole play of its operations is limited and measured by the intentions of its constructor. If that constructor be himself limited either in opportunity, or knowledge, or in power, there will be a corresponding limitation in the things which he invents and makes. Accordingly, in regard to man, he cannot make a machine which has any of the gifts and the powers of life. He can construct nothing which has sensibility or consciousness or any other of even the lowest attributes of living creatures. And this absolute destitution of even apparent originality in a machine—this entire absence of any share of consciousness, or of sensibility, or of will—is one part of our very conception of it.—ARGYLL *Unity of Nature*, ch. 3, p. 57. (Burt.)

2003. MACHINE NEVER CREATES POWER—No engine, however subtly devised, can evade this law of equivalence, or perform on its own account the smallest modicum of work. The machine distributes, but it cannot create.—TYNDALL *Heat a Mode of Motion*, lect. 3, p. 83. (A., 1900.)

2004. MACHINE, THE HUMAN BODY A—*Digestion of Food—Breathing—Voluntary Movements.*—Most undoubtedly, the digestion of food in the human body is a purely chemical process; and the passage of the nutritive parts of that food into the blood, a physical operation. Beyond all question, the circulation of the blood is simply a matter of mechanism, and results from the structure and arrangement of the parts of the heart and vessels, from the contractility of those organs, and from the regulation of that contractility by an automatically acting nervous apparatus. The progress of physiology has further shown that the contractility of the muscles and the irritability of the nerves are purely the

results of the molecular mechanism of those organs; and that the regular movements of the respiratory, alimentary, and other internal organs are governed and guided as mechanically by their appropriate nervous centers. The even rhythm of the breathing of every one of us depends upon the structural integrity of a particular region of the medulla oblongata, as much as the ticking of a clock depends upon the integrity of the escapement. You may take away the hands of a clock and break up its striking machinery, but it will still tick; and a man may be unable to feel, speak, or move, and yet he will breathe.—HUXLEY *Lay Sermons*, serm. 14, p. 334. (G. P. P., 1899.)

2005. ——— ——— *Soul the Directing Agent, Not the Motive Power.*—The human body is itself an admirably contrived complex machine, furnished with levers, pulleys, cords, valves, and other appliances for the application and modification of the power derived from the food. It is, in fact, a locomotive-engine, impelled by the same power which under another form gives activity and energy to the iron horse of the railway. In both, the power is derived from combustion of the carbon and hydrogen of the organic matter employed for food or fuel. In both, the direction of power is under the influence of an immaterial, thinking, willing principle called the soul. But this must not be confounded,' as it frequently is, with the motive power. The soul of a man no more moves his body than the soul of the engineer moves the locomotive and its attendant train of cars. In both cases the soul is the directing, controlling principle, not the impelling power. Let, for example, a locomotive-engine be placed upon the track, with water in the boiler and fire in the grate—in short, with all the potentials of motion, and it will still remain quiescent. In this state let the engineer enter the tender and touch the valve: the machine instantly becomes instinct with life and volition: it has now a soul to govern its power and direct its operations; and indeed as a whole it may be considered as an enormous animal, of which the wheels and other parts are additions to the body of the engineer.—HENRY *Improvement of the Mechanical Arts, Scientific Writings*, vol. i, p. 312. (Sm. Inst., 1886.)

2006. MACHINERY, PRIMITIVE SUBSTITUTES FOR—*Predecessor of the Suction-pump—Storage of Water by African Women.*—Whether women invented the suction-pump may remain in doubt, but the Bakalahari dames [according to Livingstone], when they wish to draw water, provide twenty or thirty ostrich-egg shells and place them in a net. They tie a bunch of grass to one end of a short reed for a strainer, and insert the apparatus in a hole as deep as the arm will reach, then ram down the wet sand firmly round it. Applying the mouth to the free end of the reed, they draw the water upward by sucking, and discharge it into an ostrich shell, guiding the stream by means of a straw. The whole stock of water passes through the woman's mouth as a pump. The shells are taken home and buried in wet sand for future use —MASON *Woman's Share in Primitive Culture*, ch. 2, p. 25. (A., 1894.)

2007. MAGNET AND AMBER IN CHINA—*A "Breath" Animating Both.*—The earliest reference to [the] attractive property [of amber] is also apparently the first mention of the like property of the magnet and appears in a "Eulogy of the Magnet," written by Kouo pho in 324 A. D., in the following words:

"The magnet draws the iron, and the amber extracts mustard-seeds. There is a breath which penetrates secretly and with velocity, and which communicates itself imperceptibly to that which corresponds to it in the other object. It is an inexplicable thing."

But this is nothing more than a restatement of the European notion of the flow, or virtue, or current, or soul, emanating from the stone or the amber, with which theory the Western civilized world was then familiar, and which, it is safe to say, involves a power of abstract conception which the Chinese mind has never possessed.—PARK BENJAMIN *Intellectual Rise in Electricity*, ch. 3, p. 74. (J. W., 1898.)

2008. MAGNET IN GREEK CLASSICS—*Simile of Plato—Transmitted Attraction.*—The first mention of the magnet in the Greek classics is apparently that made in the fragmentary "Œneus" of Euripides, which Suidas quotes, and which distinctly refers to the attraction of the lodestone for the iron. The subject takes definite form, however, in the "Ion" of Plato; and there, in the following words, Socrates describes the famous rings:

"The gift which you have of speaking excellently about Homer is not an art," says the sage, "but, as I was just saying, an inspiration: there is a divinity moving you, like that in the stone which Euripides calls a magnet, but which is commonly known as the stone of Heraclea. For that stone not only attracts iron rings, but also imparts to them similar power of attracting other rings: and sometimes you may see a number of pieces of iron and rings suspended from one another, so as to form quite a long chain; and all of these derive their powers of suspension from the original stone. Now, this is like the muse who first gives to men inspiration herself, and from those inspired, her sons, a chain of other persons is suspended, who will take the inspiration from them."

Plato lived between the years 429 and 348 B. C., and from his time forward the rings of Samothrace are described again and again.—PARK BENJAMIN *Intellectual Rise in Electricity*, ch. 1, p. 23. (J. W., 1898.)

2009. MAGNET, TEMPORARY OR PERMANENT—*Plasticity of Iron—Coercive*

Force in Steel—Molecular Movement.—There is another kind of magnet, called a permanent magnet, that will remain a magnet after the current is taken away. The permanent magnet is made of steel and hardened; then its poles are placed to the poles of a powerful magnet, either electro or permanent, when its molecular rings are wrenched apart and arranged in a polarized position, as heretofore described. Now take it away from the magnet and it will be found to retain its magnetism. The molecules tend to fly back the same as those of the soft iron, but they cannot because hardened steel is so much finer grained than soft iron, and the molecules are so close together that they are held in position by a friction that is called its coercive force. The soft iron is comparatively free from this coercive force, because its molecules are free to move on each other, so that when they are wrenched out of their natural position they fly back by their own attractions as soon as the force holding them apart is taken away. The molecules of hardened steel are unable to fly back, altho they tend to do it just as much as in the iron, and so it is called a permanent magnet. Its molecules also are under a strain like a bent bow. (The form of such a magnet is usually that of a horseshoe or U.)—ELISHA GRAY *Nature's Miracles*, vol. iii, ch. 4, p. 28. (F. H. & H., 1900.)

2010. MAGNITUDE OF MOUND-BUILDER'S WORKS—*Impressive in Vastness and Simplicity.*—The most remarkable group [of North-American mounds] is that near Newark, in the Scioto Valley, which covers an area of four square miles! A plan of these gigantic works is given by Messrs. Squier and Davis, and another, from a later survey, by Mr. Wilson. They consist of an octagon, with an area of fifty, a square occupying twenty acres, and two large circles occupying respectively thirty and twenty acres. From the octagon an avenue formed by parallel walls extends southwards for two miles and a half; there are two other avenues which are rather more than a mile in length, one of them connecting the octagon with the square. . . . The whole area is covered with "gigantic trees of a primitive forest"; and, say Messrs. Squier and Davis, "in entering the ancient avenue for the first time, the visitor does not fail to experience a sensation of awe, such as he might feel in passing the portals of an Egyptian temple or gazing upon the silent ruins of Petra of the Desert."—AVEBURY *Prehistoric Times*, ch. 8, p. 246. (A., 1900.)

2011. MAGNITUDE OF SUN—*Illustrated by Distance from Earth to Moon.*—Since the diameter of the sun is 858,000 miles, there are 429,000 miles from its center to its surface. Now, there are 238,000 miles from here to the moon. If, then, we could place the earth at the center of the sun, like a small kernel in the middle of a colossal fruit, the moon would revolve in the interior of the solar globe, and the distance of the moon would hardly represent more than half the way from the center to the solar surface; to reach this surface from the lunar orbit there would still remain 191,000 miles to pass over!—FLAMMARION *Popular Astronomy*, bk. iii, ch. 2, p. 237. (A.)

2012. MAGNITUDE, REAL AND APPARENT—*First Impressions Do Not Give Deepest Truth.*—In April there shines towards the west a star so far surpassing all others in the heavens in brightness, that it might well be believed to be the most important of all the orbs discernible by us. It is Hesperus, the star of the evening, the planet Venus; and, in reality, so far from being the largest of all the orbs we see, there are but two celestial bodies, besides the moon, which are smaller than this beautiful planet. The planet Jupiter, [tho] . . . far inferior in brightness to Venus, is in reality a globe surpassing her more than thirteen hundred times in volume, . . . while the splendid Sirius, which shines less brightly far than Jupiter, probably surpasses Venus in bulk more than a thousand millions of times.—PROCTOR *Expanse of Heaven*, p. 47. (L. G. & Co., 1897.)

2013. MAMMALIA IN GEOLOGIC TIME—*Elephants in Northern Lands—Mastodon and Dinotherium.*—Mammalian life probably culminated or attained to its maximum in the Miocene and the Early Pliocene periods. Then there were more numerous, larger, and better-developed quadrupeds on our continents than we now find. For example, the elephants, the noblest of the mammals, are at present represented by two species confined to India and parts of Africa. In the Middle Tertiary there were, in addition to the ordinary elephants, two other genera, *Mastodon* and *Dinotherium*, and there were many species which were distributed over the whole northern hemisphere. The sub-Himalayan deposits of India alone have, I believe, afforded seven species, some of them of grander dimensions than either of those now existing. We have no trustworthy evidence as yet that man lived at this period. If he had, he either would have required the protection of a special Eden, or would have needed superhuman strength and sagacity.—DAWSON *Facts and Fancies in Modern Science*, ch. 4, p. 147. (A. B. P. S.)

2014. MAMMALIA OF THE WATERS—*The Whale and Porpoise Not Fishes.*—It is very difficult, for example, to persuade persons ignorant of the principles of anatomy, that the whale and the porpoise are not fish, that they breathe with lungs as man breathes, that they would be drowned if kept long under water, and that, as they suckle their young, they belong to the same great class, *Mammalia*. Living in the same element as fish, and feeding very much as fishes feed, a similar outward form has been given

to them, because that form is the best adapted for progression through the water. But that form has been, so to speak, put on round the mammalian skeleton, and covers all the organs proper to the mammalian class. Whales and porpoises, notwithstanding their form, and their habitat, and their food, are as separate from fishes as the elephant, or the hippopotamus, or the giraffe. —ARGYLL *Reign of Law,* ch. 4, p. 119. (Burt.)

2015. MAMMALIA THE CROWN OF ANIMAL DEVELOPMENT—*Nature's Supreme Purpose to Create the Mother and the Family.*—Ask the zoologist what, judging from science alone, Nature aspired to from the first, he could but answer, *Mammalia*—mothers. In as real a sense as a factory is meant to turn out locomotives or clocks, the machinery of Nature is designed in the last resort to turn out mothers. You will find mothers in lower nature at every stage of imperfection; you will see attempts being made to get at better types; you find old ideas abandoned and higher models coming to the front. And when you get to the top you find the last great act was but to present to the world a physiologically perfect type. It is a fact which no human mother can regard without awe, which no man can realize without a new reverence for woman and a new belief in the higher meaning of Nature, that the goal of the whole plant and animal kingdoms seems to have been the creation of a family, which the very naturalist has had to call *Mammalia.*—DRUMMOND *Ascent of Man,* ch. 8, p. 268. (J. P., 1900.)

2016. MAMMOTH LINKS OLD WORLD WITH NEW—*Giant Organisms Perishable.*—The mammoth, or *Elephas primigenius,* had very extensive geographical range. Its remains are found in North America, but not east of the Rocky Mountains nor south of Columbia River; in the Old Continent, from the farthest extremity of Siberia to the extreme west of Europe, occurring, tho rarely, even in Ireland; it crossed the Alps, and established itself in Italy as far southward as Rome, but it has not yet been discovered in Naples, in any of the Mediterranean islands, or in Scandinavia. In Spain and Denmark it occurs, but is very rare.—AVEBURY *Prehistoric Times,* ch. 9, p. 273. (A., 1900.)

2017. MAN, ADAPTATION OF, TO ERECT POSTURE—*Structure of Manlike Apes Brings Body Down.*—In man the opening at the base of the skull (occipital foramen), through which the spinal cord passes up into the brain, is farther to the front than in the apes, so that his skull, instead of pitching forward, is balanced on the top of the atlas vertebra (so called from Atlas supporting the globe). . . . As he stands upright, the feet serve as bases, enabling the legs to carry the trunk. Thus the erect posture, only imitated with difficult effort by the showman's performing animals, is to man easy and unconstrained. . . . Of the monkey tribes, many walk fairly on all fours as quadrupeds, with legs bent, arms straightened forward, soles and palms touching the ground. But the higher manlike apes are adapted by their structure for a climbing life among the trees, whose branches they grasp with feet and hands. When the orang-utan takes to the ground he shambles clumsily along, generally putting down the outer edge of the feet and the bent knuckles of the hands. The orang and gorilla have the curious habit of resting on their bent fists, so as to draw their bodies forward between their long arms, like a cripple between his crutches. The nearest approach that apes naturally make to the erect attitude is where the gibbon will go along on its feet, touching the ground with its knuckles first on one side and then on the other, or will run some distance with its arms thrown back above its head to keep the balance, or when the gorilla will rise on its legs and rush forward to attack. . . . The apes thus present interesting intermediate stages between quadruped and biped. But only man is so formed that, using his feet to carry him, he has his hands free for their special work.—TYLOR *Anthropology,* ch. 2, p. 40. (A., 1899.)

2018. MAN A MACHINE OF INFINITE DELICACY—*The Rifle Calculable, the Sportsman Incalculable—Human Actions Defy Prediction.*—Altho it is undoubtedly a delicately constructed machine, yet a rifle does not represent the same surpassing delicacy as that, for instance, which characterizes an egg balanced on its longer axis. Even if at full cock, and with a hair-trigger, we may be perfectly certain it will not go off of its own accord. Altho its object is to produce a sudden and violent transmutation of energy, yet this requires to be preceded by the application of an amount of energy, however small, to the trigger, and if this be not spent upon the rifle it will not go off. There is, no doubt, delicacy of construction, but this has not risen to the height of incalculability, and it is only when in the hands of the sportsman that it becomes a machine upon the condition of which we cannot calculate. Now, in making this remark, we define the position of the sportsman himself in the universe of energy. The rifle is delicately constructed, but not surpassingly so; but sportsman and rifle together form a machine of surpassing delicacy, *ergo* the sportsman himself is such a machine. We thus begin to perceive that a human being, or indeed an animal of any kind, is in truth a machine of a delicacy that is practically infinite, the condition or motions of which we are utterly unable to predict. In truth, is there not a transparent absurdity in the very thought that a man may become able to calculate his own movements, or even those of his fellow?—STEWART *Conservation of Energy,* ch. 6, p. 412. (Hum., 1880.)

2019. MAN AND APE—*No Trace of the Missing Link.*—In vain have we sought for the connecting links between man and the apes; the ancestor of man, the real *Proanthropos*, has not been found. Twenty years ago it seemed as if the process of descent from the ape to man could be constructed by storm. Now, however, we cannot even trace the descent of the different races from one another. At this moment we can say that among people of ancient times none have been found who were nearer the apes than we are. I can affirm at present that there is no absolutely unknown race of men on earth. Every living race is human; none has been found which we could either call simian or between the ape and man. So far as the pile structures are concerned, I have been able to examine nearly all the skulls found, and the result is that we find differences between the various tribes, but that not one of these tribes lies outside of the range of still existing people. It can be definitely proved that in the course of five thousand years no change of types worthy of mention has occurred.—VIRCHOW *Address before the Anthropological Congress in Vienna, 1889.* (Translated for *Scientific Side-Lights.*)

2020. ——— ——— *Physical Likeness with Mental Remoteness.*—One of the chief factors in the production of man was the change that occurred in the direction of the working of natural selection, whereby in the line of man's direct ancestry the variations in intelligence came to be seized upon, cherished, and enhanced, to the comparative neglect of variations in bodily structure. The physical differences between man and ape are less important than the physical differences between African and South-American apes. The latter belong to different zoological families, but the former do not. Zoologically, man is simply one genus in the Old-World family of apes. Psychologically, he has traveled so far from apes that the distance is scarcely measurable.—FISKE *Through Nature to God*, pt. i, ch. 9, p. 49. (H. M. & Co., 1900.)

2021. ——— ——— *Unfilled Gap between.*—Even Haeckel admits that there is a wide gap, unfilled by any recent or any fossil creature, between man and the highest apes.—DAWSON *Facts and Fancies in Modern Science*, lect. 4, p. 142. (A. B. P. S.)

2022. MAN AND MIMOSA—*Man Has What Is in Mimosa—Mimosa Has Not What Is in Man.*—To say that self-consciousness has arisen from sensation, and sensation from the function of nutrition, let us say, in the *Mimosa pudica*, or sensitive plant, may be right or wrong; but the error can only be serious when it is held that that accounts either for self-consciousness or for the transition. *Mimosa* can be defined in terms of man; but man cannot be defined in terms of *Mimosa*. The first is possible because there is the least fraction in that which is least in man of that which is greatest in *Mimosa;* the last is impossible because there is nothing in *Mimosa* of that which is greatest in man. . . . Man, in the last resort, has self-consciousness, *Mimosa* sensation, and the difference is qualitative as well as quantitative.—DRUMMOND *Ascent of Man*, ch. 4, p. 126. (J. P., 1900.)

2023. MAN AND WOMAN TAUGHT BY DIFFERENT ANIMAL TEACHERS—In contact with the animal world, and ever taking lessons from them, men watched the tiger, the bear, the fox, the falcon, learned their language and imitated them in ceremonial dances. But women were instructed by the spiders, the nest-builders, the storers of food, and the workers in clay, like the mud-wasp and the termites. It is not meant that these creatures set up schools to teach dull women how to work, but that their quick minds were on the alert for hints coming from these sources. Even tho we disarm our soldiery, we do not seem to be able to dissociate men from the works that bring violent death. It is in the apotheosis of industrialism that woman has borne her part so persistently and well. At the very beginning of human time she laid down the lines of her duties, and she has kept to them unremittingly.—MASON *Woman's Share in Primitive Culture*, ch. 1, p. 2. (A., 1894.)

2024. MAN, ANTIQUITY OF—*Languages Developed in Prehistoric Time.*—The main work of language-making was done in the ages before history. Going back as far as philology can take us, we find already existing a number of language-groups, differing in words and structure, and, if they ever had any relationship with one another, no longer showing it by signs clear enough for our skill to make out. Of an original primitive language of mankind, the most patient research has found no traces. The oldest types of language we can reach by working back from known languages show no signs of being primitive tongues of mankind. Indeed, it may be positively asserted that they are not such, but that ages of growth and decay have mostly obliterated the traces how each particular sound came to express its particular sense. Man, since the historical period, has done little in the way of absolute new creation of language, for the good reason that his wants were already supplied by the words he learnt from his fathers, and all he had to do when a new idea came to him was to work up old words into some new shape. Thus the study of languages gives much the same view of man's antiquity as has been already gained from the study of races. The philologist, asked how long he thinks mankind to have existed, answers that it must have been long enough for human speech to have grown from its earliest beginnings into elaborate languages, and for these in their turn to have developed into families spread far and

wide over the world. This immense work had been already accomplished in ages before the earliest inscriptions of Egypt, Babylon, Assyria, Phenicia, Persia, Greece, for these show the great families of human speech already in full existence.—TYLOR *Anthropology*, ch. 1, p. 12. (A., 1899.)

2025. ——— ——— *Stone Age Coeval with Buried Pine-forests.*—The question is how long ago tribes who made such stone implements were living in Europe. As to this, we may fairly judge from the position in which they are found in Denmark. The forests of that country are mainly of beeches, but in the peat-mosses lie innumerable trunks of oaks, which show that at an earlier period oak forests prevailed, and deeper still there lie trunks of pine-trees, which show that they were pine forests still older than the oak forests. Thus there have been three successive forest-periods, the beech, the oak, and the pine; and the depth of the peat-mosses, which in places is as much as thirty feet, shows that the period of the pine-trees was thousands of years ago. While the forests have been changing, the condition of the people living among them has changed also. The modern woodman cuts down the beech-trees with his iron ax, but among the oak-trunks in the peat are found bronze swords and shield-bosses, which show that the inhabitants of the country were then in the Bronze Age; and, lastly, a flint hatchet taken out from where it lay still lower in the peat beneath the pine-trunks, proves that Stone-Age men in Denmark lived in the pine-forest period, which carries them back to high antiquity. In England the tribes who have left such stone implements were in the land before the invasion of that Celtic race whom we call the ancient Britons, and who no doubt came armed with weapons of metal. The stone hatchet-blades and arrow-heads of the older population lie scattered over our country, hill and dale, moor and fen, near the surface of the ground, or deeper underground in peat-mosses or beds of mud and silt.—TYLOR *Antropology*, ch. 1, p. 26. (A., 1899.)

2026. MAN A PART OF NATURE—*Type of the Supernatural.*—All the analogies of human thought are in themselves analogies of Nature; and in proportion as they are built up or are perceived by mind in its higher attributes and work, they are part and parcel of natural truth. Man—he whom the Greeks call *Anthropos*, because, as it has been supposed, he is the only being whose look is upward—man is a part of Nature, and no artificial definitions can separate him from it. And yet in another sense it is true that man is above Nature—outside of it; and in this aspect he is the very type and image of the "supernatural."—ARGYLL *Unity of Nature*, ch. 8, p. 183. (Burt.)

2027. MAN AS A MEAT-EATER—Helvetius claimed that man was intended to be carnivorous; J. J. Rousseau maintained, on the contrary, that, like the anthropoids and the primates in general, man is herbivorous, and tends to become carnivorous in proportion as he develops. The prehistoric man was herbivorous and frugivorous. Later, the invention of stone instruments fitted him to pursue fishing and the chase. Finally, the domestication of certain animals furnished him with a constant provision of meat. It was thus that from being herbivorous man has become omnivorous. But for a long period meat played only a secondary rôle in the alimentation of the superior races. It is only within the last century that this rôle has increased to such proportions that Europe has become actually more carnivorous than herbivorous. In France, for example, the food, which was almost exclusively vegetable up to a hundred years ago, tends more and more to become animal.—DELAUNAY *Études de Biologie comparées*, 2e *partie*, p. 34. (Translated for *Scientific Side-Lights.*)

2028. MAN AS AN INSTRUMENT OF RESEARCH—*Specialists in German Universities.*—The German universities are proud of the number of young specialists whom they turn out every year, not necessarily men of any original force of intellect, but men so trained to research that when their professor gives them an historical or philological thesis to prepare, or a bit of laboratory work to do, with a general indication as to the best method, they can go off by themselves and use apparatus and consult sources in such a way as to grind out in the requisite number of months some little pepper-corn of new truth worthy of being added to the store of extant human information on that subject. Little else is recognized in Germany as a man's title to academic advancement than his ability thus to show himself an efficient instrument of research.—JAMES *Talks to Teachers*, ch. 4. p. 31. (H. H. & Co., 1900.)

2029. MAN AS A SEED-DISTRIBUTER—*Commerce and Agriculture—Good and Evil Spread Abroad.*—The agency of man in the distribution of plants exceeds in importance that of all other means combined. He buys and sells seeds and plants, and sends them to all parts of the habitable globe. He exterminates many plants in large areas, and substitutes in large measure those of his choice. Mixed with seeds of grasses, clovers, or grains, he introduces many weeds and sows them to grow with his crops.—BEAL *Seed Dispersal*, ch. 8, p. 81. (G. & Co., 1898.)

2030. MAN A UNITY, AS A TREE IS NOT—*Nervous System Makes the Difference.*—If I begin chopping the foot of a tree its branches are unmoved by my act, and its leaves murmur as peacefully as ever in

the wind. If, on the contrary, I do violence to the foot of a fellow man, the rest of his body instantly responds to the aggression by movements of alarm or defense. The reason of this difference is that the man has a nervous system, whilst the tree has none; and the function of the nervous system is to bring each part into harmonious cooperation with every other.—JAMES *Psychology*, vol. i, ch. 1, p. 12. (H. H. & Co., 1899.)

2031. MAN A UNIVERSAL DWELLER ON THE EARTH—*Unity of the Race.*—From the earliest times when civilized men began to explore distant regions, they found everywhere other races of men already established. And this has held true down to the latest acquisitions of discovery. When the New World was discovered by Columbus he found that it must have been a very old world indeed to the human species. Not only every great continent, but, with rare exceptions, even every habitable island has been found peopled by the genus *Homo*. The explorers might find, and in many cases did actually find, everything else in Nature different from the country of their birth. Not a beast, or bird, or plant, not an insect, or a reptile, or a fish, might be the same as those of which they had any previous knowledge. The whole face of Nature might be new and strange—but always with this one solitary exception, that everywhere man was compelled to recognize himself—represented, indeed, often by people of strange aspect and of strange speech, but by people, nevertheless, exhibiting all the unmistakable characters of the human race.—ARGYLL *Unity of Nature*, ch. 10, p. 234. (Burt.)

2032. MAN BEHIND INSTRUMENT—*Great Discoveries with Small Telescopes.*—We know that Galileo made his discoveries of Jupiter's satellites with an instrument that magnified only seven diameters, and that he never could have used one of a higher power than thirty-two. . . .

During the many years I passed at the Paris Observatory I frequently had in my hands the instruments made by Campani, which were in such great repute during the reign of Louis XIV.; and when we consider the faint light of Saturn's satellites, and the difficulty of managing instruments worked by strings only, we cannot sufficiently admire the skill and the untiring perseverance of the observer.—HUMBOLDT *Cosmos*, vol. iii, p. 61. (H., 1897.)

2033. MAN BUILDS CIVILIZATION BY CHANGING THE PLACES OF THINGS—The miner moves the ore and the fuel from their subterranean resting-places, then they are moved into the furnace, and by another moving of combustibles the working of the furnace is started; then the metals are moved to the foundries and forges, then under hammers, or squeezers, or into melting-pots, and thence to molds. The workman shapes the bars, or plates, or castings by removing a part of their substance, and by more and more movings of material produces the engine, which does its work when fuel and water are moved into its fireplace and boiler. The statue is within the rough block of marble; the sculptor merely moves away the outer portions, and thereby renders his artistic conception visible to his fellow men. The agriculturist merely moves the soil in order that it may receive the seed, which he then moves into it, and when the growth is completed he moves the result, and thereby makes his harvest. The same may be said of every other operation. Man alters the position of physical things in such wise that the forces of Nature shall operate upon them, and produce the changes or other results that he requires.—WILLIAMS *Chemistry of Cookery*, ch. 1, p. 1. (A., 1900.)

2034. MAN CAN NEVER APPREHEND FIRST CAUSES—All our knowledge is limited, and we can never apprehend the *first causes* of any phenomena. The force of crystallization, the force of gravitation and chemical affinity remain in themselves just as incomprehensible as adaptation and inheritance or will and consciousness.—HAECKEL *History of Creation*, vol. i, ch. 2, p. 33. (K. P. & Co., 1899.)

2035. MAN CHANGING NATURAL PRODUCTS—*Nature's Changes Slow—Those Wrought by Human Agency Sudden.*—What Nature brings about in a great lapse of time we occasion suddenly by changing the circumstances in which a species has been accustomed to live. All are aware that vegetables taken from their birthplace and cultivated in gardens undergo changes which render them no longer recognizable as the same plants. Many which were naturally hairy become smooth, or nearly so; a great number of such as were creepers and trailed along the ground rear their stalks and grow erect. Others lose their thorns or asperities; others, again, from the ligneous state which their stem possessed in hot climates, where they were indigenous, pass to the herbaceous: and, among them, some which were perennials become mere annuals. So well do botanists know the effects of such changes of circumstances that they are averse to describe species from garden specimens, unless they are sure that they have been cultivated for a very short period.—LYELL *Principles of Geology*, bk. iii, ch. 33, p. 569. (A., 1854.)

2036. MAN, CIVILIZED, BECOMES MASTER OF HIS ENVIRONMENT—The serious mistake made by Buckle is that he thought what is true of man in his savage state is also true of him during all the stages of his development—namely, that man always remains under the dominion of his environment. The truth, however, is that man frees himself from his environment in proportion as he rises in civilization, so that instead of being Nature's slave he becomes its master.—BASTIAN *Remark While Guid-*

ing the Philosophical Society of Berlin through the Ethnographical Museum. (Translated for *Scientific Side-Lights.)*

2037. MAN, CIVILIZED, CONSUMING THE EARTH'S CAPITAL—It seems to me impossible to consider what is actually taking place on the earth at present without perceiving that within periods, short, indeed, by comparison with geological eras, and still shorter compared with the intervals to which the astronomical history of our earth has introduced us. the condition of the earth as an abode of life will be seriously modified by the ways and works of man. . . . Civilized man is not content to take his share of the earth's income—he uses the garnered wealth which is the earth's capital, and this at a rate which is not only ever increasing, but is increasing at an increasing rate. The rapid consumption of coal is but a single instance of his wasteful expenditure of the stores which during countless ages have been gathered together seemingly for the use of man.—PROCTOR *Our Place among Infinities*, p. 25. (L. G. & Co., 1897.)

2038. MAN COMPARED WITH LOWER ANIMALS—*Resemblance and Contrast.*—It is now more than thirty years since Dr. Pritchard, who, perhaps, of all others merits the title of founder of modern anthropology, stated in the following forcible passage, which opens his "Natural History of Man," the closeness of man's physical relation to the lower animals: "The organized world presents no contrasts and resemblances more remarkable than those which we discover on comparing mankind with the inferior tribes. That creatures should exist so nearly approaching to each other in all the particulars of their physical structure, and yet differing so immeasurably in their endowments and capabilities, would be a fact hard to believe if it were not manifest to our observation. The differences are everywhere striking; the resemblances are less obvious in the fulness of their extent, and they are never contemplated without wonder by those who, in the study of anatomy and physiology, are first made aware how near is man in his physical constitution to the brutes. In all the principles of his internal structure. in the composition and functions of his parts, man is but an animal. The lord of the earth, who contemplates the eternal order of the universe, and aspires to communion with its invisible Maker. is a being composed of the same materials, and framed on the same principles, as the creatures which he has tamed to be the servile instruments of his will. or slays for his daily food. The points of resemblance are innumerable; they extend to the most recondite arrangements of that mechanism which maintains instrumentally the physical life of the body. which brings forward its early development, and admits, after a given period, its decay, and by means of which is prepared a succession of similar beings destined to perpetuate the race."—DANIEL WILSON *Anthropology*, ch. 2, p. 2. (Hum., 1885.)

2039. MAN CONSTRUCTS IMAGINARY CHARACTER — *Imagines Himself What He Would Have Men Believe Him.*—It is plain that the external conditions of life impose on the individual certain habits of feeling which often conflict with his personal propensities. As a member of society he has a powerful motive to attribute certain feelings to himself, and this motive acts as a bias in disturbing his vision of what is actually in his mind. While this holds good of lighter matters, as that of enjoyment, it applies still more to graver matters. Thus, for example, a man may easily persuade himself that he feels a proper sentiment of indignation against a perpetrator of some mean or cruel act, when as a matter of fact his feeling is much more one of compassion for the previously liked offender. In this way we impose on ourselves, disguising our real sentiments by a thin veil of make-believe.—SULLY *Illusions*, ch. 8, p. 202. (A., 1897.)

2040. MAN CONTEMPORARY WITH EXTINCT ANIMALS—*The Irish Elk in England and France.*—It must be regarded as a well-ascertained fact that even during the human period the pleasant and sunny valleys of England and of France have been inhabited by the gigantic Irish elk, two species of elephant, and three of rhinoceros, together with the reindeer, a large bear closely resembling the grizzly bear of the Rocky Mountains, a bison scarcely distinguishable from that of the American prairies, the musk-ox of Arctic America, the lemming of the Siberian steppes, the lion of the tropics, the hyena of the Cape, and a hippopotamus closely resembling that of the great African rivers.—AVEBURY *Prehistoric Times*, ch. 9, p. 289. (A., 1900.)

2041. MAN DEVELOPS IN MIND, AS ANIMALS IN BODY—*Increasing Harmony with Environment.*—[That] principle of natural selection which in animals affects the body and seems to have little influence on the mind, in man affects the mind and has little influence on the body. In the first, it tends mainly to the preservation of life; in the second, to the improvement of the mind, and consequently to the increase of happiness. It insures, in the words of Mr. Herbert Spencer, "a constant progress towards a higher degree of skill, intelligence, and self-regulation, a better coordination of actions, a more complete life." . . . The tendency of recent improvements and discoveries is less to effect any rapid change in man himself than to bring him into harmony with Nature; less to confer upon him new powers than to teach him how to apply the old.—AVEBURY *Prehistoric Times*, ch. 16, p. 576. (A., 1900.)

2042. MAN EMPHASIZES NATURE'S VARIATIONS — We cannot suppose that all the breeds were suddenly produced as perfect and as useful as we now see them; indeed, in many cases, we know that this has not been their history. The key is man's power of accumulative selection: Nature gives successive variations; man adds them up in certain directions useful to him. In this sense he may be said to have made for himself useful breeds.—DARWIN *Origin of Species*, ch. 1, p. 26. (Burt.)

2043. MAN, EVIDENCES OF HIS RECENT ORIGIN—*Fossils of Existing Organisms Where Still No Human Trace.*—Thus, for example, in the deposits called the "northern drift," or the glacial formation of Europe and North America, the fossil marine shells can easily be identified with species either now inhabiting the neighboring sea, or living in the seas of higher latitudes. Yet they exhibit no memorials of the human race, or of articles fabricated by the hand of man. Some of the newest of these strata, passing by the name of "raised beaches," occur at moderate elevations on the coast of England, Scotland, and Ireland. Other examples are met with on a more extended scale in Scandinavia, as at the height of 200 feet at Uddevalla in Sweden, and at twice that elevation near Christiania in Norway, also at an altitude of 600 or 700 feet in places farther north. They consist of beds of sand and clay, filling hollows in a district of granite and gneiss, and they must closely resemble the accumulations of shelly matter now in progress at the bottom of the Norwegian fiords. The rate at which the land is now rising in Scandinavia is far too irregular in different places to afford a safe standard for estimating the minimum of time required for the upheaval of the fundamental granite, and its marine shelly covering, to the height of so many hundred feet; but according to the greatest average, of five or six feet in a century, the period required would be very considerable, and nearly the whole of it, as well as the antecedent epoch of submergence, seems to have preceded the introduction of man into these parts of the earth.—LYELL *Principles of Geology*, bk. i, ch. 13, p. 184. (A., 1854.)

2044. MAN, FOSSIL REMAINS OF—*Not an Ape-like Creature—Tools and Implements Show Primeval Man Thoroughly Human.*—In conclusion, I may say that the fossil remains of man hitherto discovered do not seem to me to take us appreciably nearer to that lower pithecoid form by the modification of which he has, probably, become what he is. And considering what is now known of the most ancient races of men; seeing that they fashioned flint axes and flint knives and bone-skewers of much the same pattern as those fabricated by the lowest savages at the present day, and that we have every reason to believe the habits and modes of living of such people to have remained the same from the time of the mammoth and the tichorhine rhinoceros till now, I do not know that this result is other than might be expected.—HUXLEY *Man's Place in Nature*, p. 253. (Hum.)

2045. MAN HAS MYSTERIOUS POWER OVER PUMA—*Even Child Safe with South-American Lion.*—How strange that this most cunning, bold, and bloodthirsty of the *Felidæ* [the puma], the persecutor of the jaguar and the scourge of the ruminants in the regions it inhabits, able to kill its prey with the celerity of a rifle-bullet, never attacks a human being! Even the cowardly, carrion-feeding dog will attack a man when it can do so with impunity: but in places where the puma is the only large beast of prey, it is notorious that it is there perfectly safe for even a small child to go out and sleep on the plain. At the same time it will not fly from man (tho the contrary is always stated in books of natural history) except in places where it is continually persecuted. Nor is this all: it will not, as a rule, even defend itself against man, altho in some rare instances it has been known to do so.—HUDSON *Naturalist in La Plata*, ch. 2, p. 36. (C. & H., 1895.)

2046. MAN HAS SELECTING POWER—*Abstract Conceptions—Self-contemplation.*—There is such a gulf between the faculties of his [man's] mind and those of the lower animals that the forces acting on the human spirit become, by comparison, innumerable, and involve motives belonging to a wholly different class and order. He is exposed, indeed, to the lower motives in common with the beasts. But there are others which operate largely upon him which never can and never do operate upon them. Foremost among these are the motives which man has the power of bringing to bear upon himself, arising out of his power of forming abstract ideas, out of his possession of beliefs, and, above all, out of his sense of right and wrong. So strong are these motives that they are able constantly to overpower, and sometimes almost to destroy, the forces which are related to his lower faculties. Again, among the motives which operate upon him man has a selecting power. He can, as it were, stand out from among them—look down from above them—compare them among each other, and bring them to the test of conscience. Nay, more, he can reason on his own character as he can on the character of another being—estimating his own weakness with reference to this and the other motive, as he is conscious how each may be likely to tell upon him. When he knows that any given motive will be too strong for him, if he allow himself to think of it, he can shut it out from his mind by "keeping the door of his thoughts." He can, and he often does, refuse the thing he sees, and hold by another thing which he cannot see. He may, and he often does, choose the invisible in preference to the

visible. He may, and he often does, walk by faith and not by sight.—ARGYLL *Reign of Law*, ch. 6, p. 182. (Burt.)

2047. MAN, HIS BODY UNDERGOES INCESSANT CHANGE—*Spiritual Identity Constitutes the Personality.*—Science proves that the elements constituting our bodies, even those which seem to have most resistance, are renewing themselves all the while, so that within a given period there is not one molecule but has been transformed; yet in spite of this incessant evolution of atoms there is a being (and that is each one of us) feeling its own identity, remembering what it thought, felt, intended, and performed, ten, twenty, thirty years ago, recognizing itself as the responsible author, accusing or congratulating itself. Without this identity, of which memory is the guardian, there is no longer human personality, nothing but a transient aggregation of molecules remaining united during the space of a human life.—BERSIER *"Souviens Toi" (a Sermon).* (Translated for *Scientific Side-Lights.)*

2048. MAN, HIS DEVELOPMENT DISTINGUISHES HIM FROM OTHER ANIMALS—The attitude of the human being toward Nature is entirely different from that of all other animate creatures upon earth. With difficulty and only with the help of adults does the child learn the use of its members, and he requires a longer time than any animal to acquire skill in the most necessary functions of life. Human knowledge and skill do not develop in all individuals as the blossoms and fruit of plants from the seed: human individuals do not, like the animals of the same species, attain to the same facility. More especially it is the peculiar gifts, the position in society, and the destiny of life affecting individual human beings that produce the greatest differences in the cultivation of their physical and mental powers.—DROBISCH *Darwinismus und Sittenlehre.* (Translated for *Scientific Side-Lights.)*

2049. MAN, HIS INFLUENCE UPON THE EARTH—*Effect of Enclosure of Land—Fertility Waiting for Protection.*—But how important an element enclosure is I plainly saw near Farnham, in Surrey. Here there are extensive heaths, with a few clumps of old Scotch firs on the distant hilltops: within the last ten years large spaces have been enclosed, and self-sown firs are now springing up in multitudes, so close together that all cannot live. When I ascertained that these young trees had not been sown or planted I was so much surprised at their numbers that I went to several points of view, whence I could examine hundreds of acres of the unenclosed heath, and literally I could not see a single Scotch fir except the old planted clumps. But on looking closely between the stems of the heath, I found a multitude of seedlings and little trees which had been perpetually browsed down by the cattle. In one square yard, at a point some hundred yards distant from one of the old clumps, I counted thirty-two little trees; and one of them, with twenty-six rings of growth, had during many years tried to raise its head above the stems of the heath, and had failed. No wonder that, as soon as the land was enclosed, it became thickly clothed with vigorously growing young firs. Yet the heath was so extremely barren and so extensive that no one would ever have imagined that cattle would have so closely and effectually searched it for food.—DARWIN *Origin of Species*, ch. 1, p. 67. (Burt.)

2050. MAN, HIS SUPREME DISTINCTION IN THE ANIMAL WORLD—*Love of and Sacrifice for Truth.*—Man strives after the truth for the sake of truth; he wants to know for the sake of knowing; his impulsion for knowledge, his tendency after light and truth, is so strong that, whether knowledge of the truth is productive of injury or advantage, he strives for it. And even if he foresees that the knowledge he has foreboded and sought after will only excite ridicule, hatred, contempt, and persecution as soon as found and communicated to others, he nevertheless persists until he finds and brings it to light. Have not men suffered severe affliction, not shunning cruel martyrdom, from love of the truth? But where in the entire realm of the animal world do you find any trace of this quality?—GRAUE *Darwinismus und Sittlichkeit (Deutsche Zeit- und Streit-Fragen*, p. 454). (Translated for *Scientific Side-Lights.)*

2051. MAN KINDRED TO THE STARS—*The Human Body Analyzed—Spectroscopic Analysis of Heavenly Bodies.*—In the South Kensington Museum there is, as everybody knows, an immense collection of objects, appealing to all tastes and all classes, and we find there at the same time people belonging to the wealthy and cultivated part of society lingering over the Louis Seize cabinets or the old majolica, and the artisan and his wife studying the statements as to the relative economy of baking-powders, or admiring Tippoo Saib's wooden tiger.

There is one shelf, however, which seems to have some attraction common to all social grades, for its contents appear to be of equal interest to the peer and the costermonger. It is the representation of a man resolved into his chemical elements, or rather an exhibition of the materials of which the human body is composed. There is a definite amount of water, for instance, in our blood and tissues, and there on the shelf are just so many gallons of water in a large vessel. Another jar shows the exact quantity of carbon in us; smaller bottles contain our iron and our phosphorus in just proportion, while others exhibit still other constituents of the body; and the whole reposes on the shelf as if ready for the coming of a new Frankenstein to re-create the

original man and make him walk about again as we do. The little vials that contain the different elements which we all bear about in small proportions are more numerous, and they suggest not merely the complexity of our constitutions, but the identity of our elements with those we have found by the spectroscope, not alone in the sun, but even in the distant stars and nebulæ; for this wonderful instrument of the new astronomy can find the traces of poison in a stomach or analyze a star, and its conclusions lead us to think that the ancients were nearly right when they called man a microcosm, or little universe. We have literally within our own bodies samples of the most important elements of which the great universe without is composed, and you and I are not only like each other, and brothers in humanity, but children of the sun and stars in a literal sense, having bodies actually made in large part of the same things that make Sirius and Aldebaran. They and we are near relatives.—LANGLEY *The New Astronomy*, ch. 8, p. 221. (H. M. & Co., 1896.)

2052. MAN MODIFYING NATURE—*Domestic Animals Remolded to His Will.*—It appears as if any special quality or modification in an animal can be obtained if we only breed it in sufficient quantity, watch carefully for the required variations, and carry on selection with patience and skill for a sufficiently long period. Thus, in sheep we have enormously increased the wool, and have obtained the power of rapidly forming flesh and fat; in cows we have increased the production of milk; in horses we have obtained strength, endurance, or speed, and have greatly modified size, form, and color; in poultry we have secured various colors of plumage, increase of size, and almost perpetual egg-laying.—WALLACE *Darwinism*, ch. 4, p. 63. (Hum.)

2053. MAN, MORAL NATURE OF—*Human Conduct the Subject-matter of the Moral Sense.*—What is the subject-matter of the moral sense? or, in other words, what is the kind of thing of which alone it takes any cognizance, and in which alone it recognizes the qualities of right and wrong?

To this fundamental question one answer, and one answer only, can be given. The things, and the only things, of which the moral sense takes cognizance are the actions of man. It can take no cognizance of the actions of machines, nor of the actions of the inanimate forces of Nature, nor of the actions of beasts, except in so far as a few of these may be supposed to possess in a low and elementary degree some of the characteristic powers of man. Human conduct is the only subject-matter in respect of which the perceptions of the moral sense arise. They are perceptions of the mind which have no relation to anything whatever except to the activities of another mind constituted like itself.—ARGYLL *Unity of Nature*, ch. 9, p. 196. (Burt.)

2054. MAN MORE FEARFUL THAN NATURE—*Spartacus in Vesuvius.*—What was the real condition of Campania during those years of dire convulsion [of Vesuvius]? "A climate where heaven's breath smells sweet and wooingly—a vigorous and luxuriant Nature unparalleled in its productions—a coast which was once the fairy-land of poets and the favorite retreat of great men. Even the tyrants of the creation loved this alluring region, spared it, adorned it, lived in it, died in it." [Forsyth's "Italy," vol. ii.] The inhabitants, indeed, have enjoyed no immunity from the calamities which are the lot of mankind; but the principal evils which they have suffered must be attributed to moral, not to physical, causes—to disastrous events over which man might have exercised a control, rather than to the inevitable catastrophes which result from subterranean agency. When Spartacus encamped his army of ten thousand gladiators in the old extinct crater of Vesuvius, the volcano was more justly a subject of terror to Campania than it has ever been since the rekindling of its fires.—LYELL *Geology*, ch. 24, p. 395. (A., 1854.)

2055. MAN MUST ACQUIRE INSTINCTS—*Habit the Process of Acquisition—Economy of Automatism.*—Man is born with a tendency to do more things than he has ready-made arrangements for in his nerve-centers. Most of the performances of other animals are automatic. But in him the number of them is so enormous that most of them must be the fruit of painful study. If practise did not make perfect, nor habit economize the expense of nervous and muscular energy, he would therefore be in a sorry plight. As Dr. Maudsley says:

"If an act became no easier after being done several times, if the careful direction of consciousness were necessary to its accomplishment on each occasion, it is evident that the whole activity of a lifetime might be confined to one or two deeds—that no progress could take place in development. A man might be occupied all day in dressing and undressing himself; the attitude of his body would absorb all his attention and energy; the washing of his hands or the fastening of a button would be as difficult to him on each occasion as to the child on its first trial; and he would, furthermore, be completely exhausted by his exertions. Think of the pains necessary to teach a child to stand, of the many efforts which it must make, and of the ease with which it at last stands, unconscious of any effort. For while secondarily automatic acts are accomplished with comparatively little weariness—in this regard approaching the organic movements, or the original reflex movements—the conscious effort of the will soon produces exhaustion."—JAMES *Psychology*, vol. i, ch. 4, p. 113. (H. H. & Co., 1899.)

2056. MAN NOT A MERE AUTOMATON—*His Automatic Actions Subordinate and Subsidiary—Each Generation Starts*

Anew.—An apparatus for controlling one of the lower animals can be turned out from the workshop of Nature sometimes in a day. The wheels are few, the works are simple, the connections require little time for adjustment or correction. Everything that a humble organism will do has been done a million times by its parents, and already the faculties have been carefully instructed by heredity and will automatically repeat the whole life and movement of their race. But when a man is made it is not an automaton that is made. This being will do new things, think new thoughts, originate new ways of life. . . . For half the life, therefore, that lies before the human offspring no storage of habit has been handed down from the past. . . . Into the infant's frame must be fitted not only the apparatus for automatic repetition of what its parents have done, but the apparatus for intelligent initiation; not only the machinery for carrying on the involuntary and reflex actions—involuntary and reflex because they have been done so often by its ancestors as to have become automatic—but for the voluntary and self-conscious life which will do new things, choose fresh alternatives, seek higher and more varied ends. The instrument which will attend to breathing even when we forget it; the apparatus which will make the heart beat even tho we try to stop it; the self-acting spring which makes the eyelid close the moment it is threatened—these and a hundred others are old and well-tried inventions which, from ceaseless practise generation after generation, work perfectly in each new individual from the start. . . . But the higher brain is comparatively a new thing in the world. It has to undertake a vaster range of duties, often totally new orders of duties; it has to do things which its forerunners had not quite learned to do, or had not quite learned to do unthinkingly, and the inconceivably complex machinery requires time to settle to its work.—DRUMMOND *Ascent of Man*, ch. 8, p. 283. (J. P., 1900.)

2057. MAN NOT PERFECT, BUT PERFECTIBLE—For the creation of man was by no means the creation of a perfect being. The most essential feature of man is his improvableness.—FISKE *Destiny of Man*, ch. 10, p. 71. (H. M. & Co., 1900.)

2058. MAN, PRIMEVAL—*Not Like Modern Degraded Races—Fuegians and Tasmanians Not Types—Brain Power of Earliest Men.*—Thus it would appear that these earliest known men are not specifically distinct from ourselves, but are a distinct race, most nearly allied to that great Turanian stock which is at the present day, and has apparently from the earliest historic times been, the most widely spread of all. Tho rude and uncultured, they were not either physically or mentally inferior to the average men of to-day, and were indeed in several respects men of high type, whose great cranial capacity might lead us to suppose that their ancestors had recently been in a higher state of civilization than themselves. It is, however, possible that this characteristic was rather connected with great energy and physical development than with high mental activity.

To the hypothesis of evolution, as applied to man, these facts evidently oppose great difficulties. They show that such modern degraded races as the Fuegians or the Tasmanians cannot present to us the types of our earlier ancestors, since the latter were men of a different and higher style. Nor do these oldest known men present any approximation in physical characters to the lower animals. Further, we may infer from their works, and from what we know of their beliefs and habits, that they were not creatures of instinct, but of thought like ourselves, and that materialistic doctrines of automatism and brain force without mind would be quite as absurd in their application to them as to their modern representatives.—DAWSON *Facts and Fancies in Modern Science*, ch. 4, p. 172. (A. B. P. S.)

2059. ——— ——— *The Embodiment of Helplessness and Homelessness.*—Go with me to that early day when the first being worthy to be called man stood upon this earth. How economical has been his endowment. There is no hair on his body to keep him warm, his jaws are the feeblest in the world, his arm is not equal to that of a gorilla, he cannot fly like the eagle, he cannot see into the night like the owl, even the hare is fleeter than he. He has no clothing, no shelter. "Foxes had holes, and the birds of the air had nests, but this man had not where to lay his head." He had no tools or industries or experience, no society or language or arts of pleasure; he had yet no theory of life and poorer conceptions of the life beyond. All Nature laughed at him. The sun said, I will blister his skin. The storm said, I will spit upon him. The sea said, I will drown him. The noxious malaria said, I will parch him with fevers. The lion, the wolf, the tiger said, I will devour him. The mountain-sheep withheld her fleece and lambs. The wild ass and the wild horse fled away in scorn. The silly fish said, I know you not, and the birds skimmed the air around him in mockery. There were no waving grain fields, nor golden corn fields, nor tempting vineyards, nor fragrant orchards.

"Poor naked wretches, on the edge of time,
That bide the pelting of this pitiless storm,
How shall your houseless heads and unfed sides defend you
From seasons such as these?"
King Lear, iii, 1.

Whatever we may say of our own golden age, surely his was not around him nor above him. If he had one at all it was within him.—MASON *The Birth of Invention*

(Address at Centenary of the American Patent System, Washington, D. C., 1891; Proceedings of the Congress, p. 404.)

2060. ——— ——— *The Neanderthal Skull Thoroughly Human—No Link between Man and Ape.*—Under whatever aspect we view this [Neanderthal] cranium, whether we regard its vertical depression, the enormous thickness of its supraciliary ridges, its sloping occiput, or its long and straight squamosal suture, we meet with ape-like characters, stamping it as the most pithecoid of human crania yet discovered. But Professor Schaaffhausen states that the cranium, in its present condition, holds 1,033.24 cubic centimeters of water, or about 63 cubic inches, and as the entire skull could hardly have held less than an additional 12 cubic inches, its capacity may be estimated at about 75 cubic inches, which is the average capacity given by Morton for Polynesian and Hottentot skulls.

So large a mass of brain as this would alone suggest that the pithecoid tendencies, indicated by this skull, did not extend deep into the organization; and this conclusion is borne out by the dimensions of the other bones of the skeleton given by Professor Schaaffhausen, which show that the absolute height and relative proportions of the limbs were quite those of an European of middle stature. The bones are indeed stouter, but this and the great development of the muscular ridges noted by Dr. Schaaffhausen are characters to be expected in savages. The Patagonians, exposed without shelter or protection to a climate possibly not very dissimilar from that of Europe at the time during which the Neanderthal man lived, are remarkable for the stoutness of their limb bones.

In no sense, then, can the Neanderthal bones be regarded as the remains of a human being intermediate between men and apes. At most, they demonstrate the existence of a man whose skull may be said to revert somewhat toward the pithecoid type. —HUXLEY *Man's Place in Nature*, p. 253. (Hum.)

2061. MAN, PRIMITIVE—*Adopts Ornament before Clothing.*—Man has been defined as the animal that is fond of finery. Before he manifests any care for clothing, unless compelled by the inclemency of his climate, he thinks of his ornament.—BASTIAN *Allgemeine Grundzüge der Ethnologie*, p. 24. (Translated for *Scientific Side-Lights.*)

2062. ——— ——— *Camel the Inseparable Companion of—The One Great Essential of Patriarchal Life—Long Historic Record of an Animal—"Ship of the Desert."*—In the poetry of the East, the camel is designated as the land ship, or the ship of the desert *(Sefynet-el-badyet)*. The camel is, however, not only the carrier in the desert, and the medium for maintaining communication between different countries, but is also, as Carl Ritter has shown ["Asien," § 610, ... "the main requirement of a nomadic mode of life in the patriarchal stage of national development, in the torrid regions of our planet, where rain is either wholly or in a great degree absent. No animal's life is so closely associated by natural bonds with a certain primitive stage of the development of the life of man as that of the camel among the Bedouin tribes, nor has any other been established in like manner by a continuous historical evidence of several thousand years."—HUMBOLDT *Views of Nature*, p. 51. (Bell, 1896.)

2063. ——— ——— *Fancy Sketch of—What Remains Indicate.*—Carrying our imagination back into the past, we see before us on the low shores of the Danish Archipelago a race of small men, with heavy overhanging brows, round heads, and faces probably much like those of the present Laplanders. As they must evidently have had some protection from the weather, it is most probable that they lived in tents made of skins. The total absence of metal in the Kjökkenmöddings [kitchen-middens] indicates that they had not yet any weapons except those made of wood, stone, horn, and bone. Their principal food must have consisted of shell-fish, but they were able to catch fish, and often varied their diet by game caught in hunting. It is evident that marrow was considered a great delicacy, for every single bone which contained any was split open in the manner best adapted to extract the precious morsel. —AVEBURY *Prehistoric Times*, ch. 7, p. 229. (A., 1900.)

2064. ——— ——— *Incapable of Abstract Conceptions—The Infinite—The Invisible—Personality Nearer and Simpler as Well.*—Those who approach the subject with the assumption that the idea of a divine Being or a superhuman personality must be a derivative, and cannot be a primary conception, allow all their language to be colored by the theory that vague perceptions of "The Invisible" or "The Infinite" in rivers, or in mountains, or in sun and moon and stars, were the earliest religious conceptions of the human mind. But this theory cannot be accepted by those who remember that there is nothing in Nature so near to us as our own nature—nothing so mysterious and yet so intelligible—nothing so invisible, yet so suggestive of energy and of power over things that can be seen. Nothing else in Nature speaks to us so constantly or so directly. Neither the infinite nor the invisible contains any religious element at all, unless as conditions of a being of which invisibility and infinitude are attributes. There is no probability that any abstract conceptions whatever about the nature or properties of material force can have been among the earliest conceptions of the human mind. Still less is it reasonable to suppose that such conceptions were more natural and

more easy conceptions than those founded on our own personality and on the personality of parents.—ARGYLL *Unity of Nature*, ch. 12. p. 300. (Burt.)

2065. ——— ——— *Remains Showing His Daily Domestic Life—The Kitchens of the Stone Age.*—The discovery of rude flint implements, and of bones still bearing the marks of knives, confirmed the suppositlon that these beds [the Kjökkenmöddings, kitchen-middens, or shell-mounds of Denmark] were not natural formations, and it subsequently became evident that they were, in fact, the sites of ancient villages: the primitive population having lived on the shore and fed principally on shell-fish, but partly also on the proceeds of the chase. In many places hearths were discovered consisting of flat stones, arranged in such a manner as to form small platforms, and bearing all the marks of fire. The shells and bones not available for food gradually accumulated round the tents and huts, until they formed deposits generally from three to five feet, but sometimes as much as ten feet in thickness, and in some cases more than three hundred yards in length, with a breadth of from one hundred to two hundred feet.—AVEBURY *Prehistoric Times*, ch. 7. p. 215. (A., 1900.)

2066. MAN, RECENT ORIGIN OF— *His Exposure to Special Dangers—Enduring Memorials of His Existence.*—No inhabitant of the land exposes himself to so many dangers on the waters as man, whether in a savage or a civilized state; and there is no animal, therefore, whose skeleton is so liable to become embedded in lacustrine or submarine deposits; nor can it be said that his remains are more perishable than those of other animals; for in ancient fields of battle, as Cuvier has observed, the bones of men have suffered as little decomposition as those of horses which were buried in the same grave. But even if the more solid parts of our species had disappeared, the impression of their form would have remained engraven on the rocks, as have the traces of the tenderest leaves of plants, and the soft integuments of many animals. Works of art, moreover, composed of the most indestructible materials, would have outlasted almost all the organic contents of sedimentary rocks. Edifices, and even entire cities, have, within the times of history, been buried under volcanic ejections, submerged beneath the sea, or engulfed by earthquakes; and had these catastrophes been repeated throughout an indefinite lapse of ages, the high antiquity of man would have been inscribed in far more legible characters on the framework of the globe than are the forms of the ancient vegetation which once covered the islands of the northern ocean, or of those gigantic reptiles which at still later periods peopled the seas and rivers of the northern hemisphere.

. . . .

But so far as our interpretation of physical movements has yet gone, we have every reason to infer that the human race is extremely modern, even when compared to the larger number of species now our contemporaries on the earth.—LYELL *Principles of Geology*, bk. i, ch. 9, pp. 147-48. (A., 1854.)

2067. MAN TESTS RESULTS OF OBSERVATION — *Knows Nature To Be a Whole.*—Nature considered rationally—that is to say, submitted to the process of thought—is a unity in diversity of phenomena; a harmony, blending together all created things, however dissimilar in form and attributes; one great whole (τὸ πᾶν) animated by the breath of life. The most important result of a rational inquiry into nature is, therefore, to establish the unity and harmony of this stupendous mass of force and matter, to determine with impartial justice what is due to the discoveries of the past and to those of the present, and to analyze the individual parts of natural phenomena without succumbing beneath the weight of the whole. Thus and thus alone is it permitted to man, while mindful of the high destiny of his race, to comprehend Nature, to lift the veil that shrouds her phenomena, and, as it were, submit the results of observation to the test of reason and of intellect.—HUMBOLDT *Cosmos*, vol. i, int., p. 24. (H., 1897.)

2068. MAN THE CROWN OF EVOLUTION—*Not To Be Surpassed, but Perfected.*—Who can fail to see that the selection of psychical variations, to the comparative neglect of physical variations, was the opening of a new and greater act in the drama of creation? Since that new departure the Creator's highest work has consisted not in bringing forth new types of body, but in expanding and perfecting the psychical attributes of the one creature in whose life those attributes have begun to acquire predominance. Along this human line of ascent there is no occasion for any further genesis of species; all future progress must continue to be not zoological, but psychological; organic evolution gives place to civilization. Thus in the long series of organic beings man is the last; the cosmic process, having once evolved this masterpiece, could thenceforth do nothing better than to perfect him.—FISKE *Through Nature to God*, pt. ii, ch. 5, p. 84. (H. M. & Co., 1900.)

2069. MAN, THE DESCENT OF—Man might just as well have descended from the sheep or the elephant as from the ape. —VIRCHOW *Address before the Anthropological Congress in Vienna.* (Translated for *Scientific Side-Lights.*)

2070. MAN THE HIGHEST BEING POSSIBLE UNDER EARTHLY CONDITIONS—*Completes Design of Animal Kingdom.* —To me the animal kingdom appears not in indefinite growth like a tree, but a temple with many minarets, none of them capable of being prolonged, while the central

dome is completed by the structure of man. The development of the animal kingdom is the development of intelligence chained to matter; the animals in which the nervous system has reached the greatest perfection are the vertebrates, and in man that part of the nervous system which is the organ of intelligence reaches, as I have sought to show, the highest development possible to a vertebrate animal, while intelligence has grown to reflection and volition. On these grounds, I believe, not that man is the highest possible intelligence, but that the human body is the highest form of human life possible, subject to the conditions of matter on the surface of the globe, and that the structure completes the design of the animal kingdom.—CLELAND, quoted by DRUMMOND in *Ascent of Man*, ch. 3, p. 113. (J. P., 1900.)

2071. MAN TRANSFORMS THE EARTH—*Makes New Environment.*—The destinies of all other living things are more and more dependent upon the will of man. It rests with him to determine, to a great degree, what plants and animals shall remain upon the earth and what shall be swept from its surface. By unconsciously imitating the selective processes of Nature he long ago wrought many wild species into forms subservient to his needs. He has created new varieties of fruit and flower and cereal grass, and has reared new breeds of animals to aid him in the work of civilization, until at length he is beginning to acquire a mastery over mechanical and molecular and chemical forces which is doubtless destined in the future to achieve marvelous results whereof to-day we little dream. Natural selection itself will by and by occupy a subordinate place in comparison with selection by man, whose appearance on the earth is thus seen more clearly than ever to have opened an entirely new chapter in the mysterious history of creation.—FISKE *Destiny of Man*, ch. 3, p. 33. (H. M. & Co., 1900.)

2072. MAN UNITED BY BODILY CONSTITUTION WITH ALL ANIMAL AND VEGETABLE LIFE—*"Of the Dust of the Ground" (Gen. ii, 7).*—Man is included in the unity of Nature, in the first place, as regards the composition of his body. Out of the ordinary elements of the material world is that body made, and into those elements it is resolved again. With all its beauties of form and of expression, with all its marvels of structure and of function, there is nothing whatever in it except some few of the elementary substances which are common in the atmosphere and the soil. The three commonest gases, oxygen, hydrogen, and nitrogen, with carbon and with sulfur, are the foundation-stones. In slightly different proportions these elements constitute the primordial combination of matter which is the abode of life. In the finished structure there appear, besides, lime, potash, and a little iron, sodium, and phosphorus. These are the constituents of the human body—of these in different combinations [it consists]—and, so far as we know, of nothing else. The same general composition, with here and there an ingredient less or more, prevails throughout the whole animal and vegetable world, and its elements are the commonest in the inorganic kingdom also.—ARGYLL *Unity of Nature*, ch. 2, p. 28. (Burt.)

2073. MAN WITHOUT AGRICULTURE — *Shell-mound Builders — Spirituous Liquors Unknown.*—If the absence of cereal remains justifies us, as it appears to do, in concluding that they [the shell-mound builders] had no knowledge of agriculture, they must certainly have sometimes suffered from periods of great scarcity, indications of which may, perhaps, be seen in the bones of the fox, wolf, and other carnivora, which would hardly have been eaten from choice; on the other hand, they were blessed in the ignorance of spirituous liquors, and saved thereby from what is at present the greatest scourge of Northern Europe.—AVEBURY *Prehistoric Times*, ch. 7, p. 231. (A., 1900.)

2074. MAN'S CONSCIOUSNESS OF POWER—*Similar Results in Nature Referred to Supreme Conscious Power.*—We are conscious of the exertion of a power when we either produce or resist motion; whenever, therefore, we see bodies in motion we infer that only by a like exertion of power could that motion have originated: so when the retardation of motion gives rise to heat, or heat (in ceasing to manifest itself as such) gives rise to expansive force, we perceive that it is only the manifestation that is changed, the fundamental power remaining the same. And as we are thus led by the "correlation" doctrine to consider the various agencies of Nature as the expression of a conscious will, we find the highest science completely according with the highest religion, in directing us to recognize the omnipresent and constantly sustaining energy of a personal Deity in every phenomenon of the universe around us, the pantheistic and anthropomorphic conceptions of his character being thus brought into harmony when we view "Nature" as the embodiment of the divine volition, the "forces of Nature" as so many diversified modes of its manifestation, and the "laws of Nature" as nothing but man's expressions of the uniformities which his limited observation can discern in its phenomena.—CARPENTER *Nature and Man*, lect. 5, p. 183. (A., 1889.)

2075. MAN'S EAGERNESS TO KNOW—*Paralysis of Investigation for a Thousand Years—Modern Scientific Revival.*—Our present mastery over the laws and phenomena of light has its origin in the desire of man to know. We have seen the ancients busy with this problem, but, like a child who uses his arms aimlessly, for want of the

necessary muscular exercise, so these early men speculated vaguely and confusedly regarding natural phenomena, not having had the discipline needed to give clearness to their insight and firmness to their grasp of principles. They assured themselves of the rectilinear propagation of light, and that the angle of incidence was equal to the angle of reflection. For more than a thousand years —I might say, indeed, for more than fifteen hundred years subsequently—the scientific intellect appears as if smitten with paralysis, the fact being that during this time the mental force, which might have run in the direction of science, was diverted into other directions.

The course of investigation, as regards light, was resumed in 1100 by an Arabian philosopher named Alhazan. Then it was taken up in succession by Roger Bacon, Vitellio, and Kepler. These men, tho failing to detect the principle which ruled the facts, kept the fire of investigation constantly burning. Then came the fundamental discovery of Snell, that corner-stone of optics, and immediately afterwards we have the application by Descartes of Snell's discovery to the explanation of the rainbow. Following this we have the overthrow, by Römer, of the notion of Descartes that light was transmitted instantaneously through space. Then came Newton's crowning experiments on the analysis and synthesis of white light, by which it was proved to be compounded of various kinds of light of different degrees of refrangibility.—TYNDALL *Lectures on Light*, p. 209. (A., 1898.)

2076. MAN'S LIKENESS TO LOWER ORGANISMS SPRINGS FROM SOME DEEP NECESSITY—Whether man has been separately created out of the inorganic elements of which his body is composed, or whether it was born of matter previously organized in lower forms, this community of structure must equally indicate a corresponding community of relations with external things, and some antecedent necessity deeply seated in the very nature of those things, why his bodily frame should be like to theirs.—ARGYLL *Unity of Nature*, ch. 2, p. 32. (Burt.)

2077. MAN'S ORIGINAL HOME—*A Garden of Eden—Rejection and Degeneracy.*—In the nature of things the original settlements of man must of necessity have been the most highly favored in the conditions he requires. If, on the commonly received theory of development, those conditions produced him, they must have reached, at the time when and in the place where he arose, the very highest degree of perfect adaptation. He must have been happy in the circumstances in which he found himself placed, and presumably he must have been contented to remain there. Equally on the theory of man being a special creation, we must suppose that when weakest and most ignorant he must have been placed in what was to him a garden—that is to say, in some region where the fruits of the earth were abundant and easily accessible. Whether this region were wide or narrow, he would not naturally leave it except from necessity. On every possible supposition, therefore, as to the origin of man, those who in the dispersion of the race were first subjected to hard and unfavorable conditions would naturally be those who had least strength to meet them, and upon whom they would have accordingly the most depressing effect. This is a process of natural rejection which is the inseparable correlative of the process of natural selection. It tends to development in a wrong direction by the combined action of two different circumstances which are inherent in the nature of the case. First, it must be always the weaker men who are driven out from comfortable homes; and, secondly, it must be always to comparatively unfavorable regions that they are compelled to fly. Under the operation of causes so combined as these it would be strange, indeed, if the physical and mental condition of the tribes which have been exposed to them should remain unchanged. —ARGYLL *Unity of Nature*, ch. 10, p. 250. (Burt.)

2078. MAN'S SOCIAL SELF—*Torture of Ostracism.*—A man's social self is the recognition which he gets from his mates. We are not only gregarious animals, liking to be in sight of our fellows, but we have an innate propensity to get ourselves noticed, and noticed favorably, by our kind. No more fiendish punishment could be devised, were such a thing physically possible, than that one should be turned loose in society and remain absolutely unnoticed by all the members thereof. If no one turned round when we entered, answered when we spoke, or minded what we did, but if every person we met "cut us dead," and acted as if we were non-existing things, a kind of rage and impotent despair would ere long well up in us, from which the cruelest bodily tortures would be a relief; for these would make us feel that, however bad might be our plight, we had not sunk to such a depth as to be unworthy of attention at all.—JAMES *Psychology*, vol. i, ch. 10, p. 293. (H. H. & Co., 1899.)

2079. MAN'S WORLD-WIDE UNITY—*Makes the Entire Earth His Province.*—There is only one species of the genus man: and all people of every time and every clime with which we are acquainted might have originated from one common stock. His residence and his diet are both unrestricted: he inhabits the whole habitable earth and feeds upon the varied materials derived from organized creation. Relatively to his moderate bulk, and in comparison with other mammifera, he attains a very advanced age. —BLUMENBACH *Manual of Natural History*, p. 35. (Translated for *Scientific Side-Lights.*)

2080. MANIA, THE COLLECTING—*Miser a Victim of This Blind Impulse—The Same Seen in Lower Animals—A Wood-rat's Collection.*—Every one collects money, and when a man of petty ways is smitten with the collecting mania for this object he necessarily becomes a miser. . . . The hoarding instinct prevails widely among animals as well as among men. Professor Silliman has thus described one of the hoards of the California wood-rat, made in an empty stove of an unoccupied house: "I found the outside to be composed entirely of spikes, all laid with symmetry, so as to present the points of the nails outward. In the center of this mass was the nest, composed of finely divided fibers of hemp packing. Interlaced with the spikes were the following: about two dozen knives, forks, and spoons: all the butchers' knives, three in number: a large carving-knife, fork, and steel; several large plugs of tobacco, . . . an old purse containing some silver, matches, and tobacco; nearly all the small tools from the tool-closets, with several large augers, . . . all of which must have been transported some distance, as they were originally stored in different parts of the house. . . . The outside casing of a silver watch was disposed of in one part of the pile, the glass of the same watch in another, and the works in still another."—JAMES *Psychology*, vol. ii, ch. 24, p. 424. (H. H. & Co., 1890.)

2081. MANUFACTURE OF NUTRITION—*The Struggle for Food To Be Reduced to a Minimum.*—At the present moment chemistry is devoting itself to the experiment of manufacturing nutrition, and with an enthusiasm which only immediate hope begets. It is not the visionaries who have dared to prophesy here. In a hundred laboratories the problem is being practically worked out, and, as one of the highest authorities assures us, "The time is not far distant when the artificial preparation of articles of food will be accomplished." [Remsen, *McClure's Magazine*, January, 1894.] Already, through the labors of other sciences, the struggle for food has been made infinitely easier than it was; but when the immediate quest succeeds, and the food of man is made direct from the elements, the struggle in all its coarser forms will practically be abolished. Civilization cannot ease the whole burden at once; the struggle for life will go on, but it will be the struggle with its fangs drawn.—DRUMMOND *Ascent of Man*, ch. 6, p. 213. (J. P., 1900.)

2082. MANUFACTURES CONDUCTED BY PRIMITIVE WOMAN—Her shop was ample enough, for it was the vaulted sky; but her tools and materials and methods were of the simplest kind. What we do in hours she accomplished in years. But if you could from some exalted position take in the exploitation of the earth and sea, the transformation of raw material into things of use, the transportation of these products in all directions, the commercial transactions involved in the sale of these commodities, you would be astonished to know how many of these wheels were set a-going by women in prehistoric times.—MASON *Woman's Share in Primitive Culture*, ch. 1, p. 4. (A., 1894.)

2083. MARCH OF INSECT ARMIES—*The Leaf-bearing Ants.*—No one can see without astonishment one of these ant armies traveling along the road they have worn so neatly for themselves, those who are coming from the trees looking like a green procession, almost hidden by the fragments of leaves they carry on their backs, while the returning troops, who have already deposited their burden, are hurrying back for more. There seems to be another set of individuals running to and fro, whose office is not quite so clear, unless it be to marshal the whole swarm and act as a kind of police. This view is confirmed by an anecdote related by an American resident here, who told us that he once saw an ant, returning without his load to the house, stopped by one of these anomalous individuals, severely chastised, and sent back to the tree apparently to do his appointed task.—AGASSIZ *Journey in Brazil*, ch. 3, p. 105. (H. M. & Co., 1896.)

2084. MARINER'S COMPASS, FIRST RECORD OF—Now follows in this old treatise of an English monk [Neckham, 1157-1217] probably the first of all known descriptions of the mariner's compass. Here it is:

"The sailors, moreover, as they sail over the sea, when in cloudy weather they can no longer profit by the light of the sun, or when the world is wrapped in the darkness of the shades of night, and they are ignorant to what part of the horizon the prow is directed, place the needle over the magnet, which is whirled round in a circle, until, when the motion ceases, the point of it (the needle) looks to north."

The paragraph from the "De Utensilibus" may be best considered simultaneously with the foregoing. The Latin words present many obscurities, to which it is needless to refer in detail here, since they are considered in the following translation:

"If, then, one wishes a ship well provided with all things, one must have also a needle mounted on a dart. The needle will be oscillated and turn until the point of the needle directs itself to the east (north), thus making known to the sailors the route which they should hold while the Little Bear is concealed from them by the vicissitudes of the atmosphere; for it never disappears under the horizon because of the smallness of the circle which it describes."—PARK BENJAMIN *Intellectual Rise in Electricity*, ch. 5, p. 128. (J. W., 1898.)

2085. ——— ——— *Probability that Occident Led Orient—A Chinese Copy.*—The presence of the compass in the early Euro-

pean fleets, manned by natural and instinctive seafarers, can be reasonably accounted for, . . . while the presence of the compass on the contemporary Chinese junks, manned by people having no inborn inclination for the sea, is a circumstance seemingly destitute of ancestry.

The identity of construction of the two instruments, European and Chinese, renders inevitable the presumption that one is an imitation of the other. As between people whose skill lies in originating and people whose skill lies in the wonderful minuteness and accuracy of their copies, few, I imagine, will hesitate in deciding which was probably the reproducer; or fail to reach a reasonable conviction that the mariner's compass of the East is literally a "Chinese copy" of the instrument which led, not the indolent Asiatic, but the daring mariners of England and Spain and Portugal and Italy to the most magnificent achievements of the human race.—PARK BENJAMIN *Intellectual Rise in Electricity*, ch. 3, p. 85. (J. W., 1898.)

2086. MARINERS PERPLEXED BY MYSTERIOUS LIGHT—*A Limited Aurora.*—The following case is thus described by Arago ("Œuvres complètes," vol. iv, p. 146): "Major Sabine and Captain J. Ross were returning in the autumn from their first arctic expedition they were still in the Greenland seas, during one of the dark nights of those regions, when they were summoned to the bridge by the officer of the watch, who had just seen something very strange. This was, ahead of the vessel and precisely on their course, a stationary light, which rose to a great height from the surface of the sea, while in all other directions the sky and horizon appeared black as pitch. There was no known danger in those regions, and the direction of the vessel was therefore not changed. When the vessel entered the circle of light the whole crew was silent, attentive, on the alert. The highest parts of the masts and sails could then be seen and all the rigging. The meteor appeared to extend for about four hundred yards. When the stern of the vessel left it it was again in darkness; there was no gradual decline in the intensity of the light. The luminous region could be seen from the stern of the ship for a long time."—ANGOT *Aurora Borealis*, ch. 2, p. 19. (A., 1897.)

2087. MARKINGS OF ANIMALS—*Colors Serving for Recognition—Bird-colors that Are Visible Only in Flight.*—Recognition marks during flight are very important for all birds which congregate in flocks or which migrate together; and it is essential that, while being as conspicuous as possible, the marks shall not interfere with the general protective tints of the species when at rest. Hence they usually consist of well-contrasted markings on the wings and tail, which are concealed during repose, but become fully visible when the bird takes flight.—WALLACE *Darwinism*, ch. 8, p. 151. (Hum.)

2088. ——— ——— *Stripes and Spots Serve for Concealment in Jungle and Forest.*—An experienced tiger-hunter, Major Walford, states in a letter that the haunts of the tiger are invariably full of the long grass, dry and pale yellow, for at least nine months of the year, which covers the ground wherever there is water in the rainy season, and he adds: "I once, while following up a wounded tiger, failed for at least a minute to see him under a tree in grass at a distance of about twenty yards—jungle open—but the natives saw him, and I eventually made him out well enough to shoot him, but even then I could not see at what part of him I was aiming. There can be no doubt whatever that the color of both the tiger and the panther renders them almost invisible, especially in a strong blaze of light, when among grass, and one does not seem to notice stripes or spots till they are dead." It is the black shadows of the vegetation that assimilate with the black stripes of the tiger; and, in like manner, the spotty shadows of leaves in the forest so harmonize with the spots of ocelots, jaguars, tiger-cats, and spotted deer as to afford them a very perfect concealment.—WALLACE *Darwinism*, ch. 8, p. 136. (Hum.)

2089. MARTYRS OF SCIENCE—*Bacon Packing Fowl with Snow—Discovery of the Refrigerating Process.*—The great apostle of experimental philosophy was destined to be its martyr. It had occurred to him that snow might be used with advantage for the purpose of preventing animal substances from putrefying. On a very cold day, early in the spring of the year 1626, he alighted from his coach near Highgate, in order to try the experiment. He went into a cottage, bought a fowl, and with his own hands stuffed it with snow. While thus engaged he felt a sudden chill, and was soon so much indisposed that it was impossible for him to return to Gray's Inn. The Earl of Arundel, with whom he was well acquainted, had a house at Highgate. To that house Bacon was carried. The earl was absent, but the servants who were in charge of the place showed great respect and attention to the illustrious guest. Here, after an illness of about a week, he expired early on the morning of Easter day, 1626. His mind appears to have retained its strength and liveliness to the end. He did not forget the fowl which had caused his death. In the last letter that he ever wrote, with fingers which, as he said, could not steadily hold a pen, he did not omit to mention that the experiment of the snow had succeeded "excellently well."—MACAULAY *Essays, Lord Bacon*, p. 270. (A., 1876.)

2090. ——— ——— *Prudence Must Guide Study—Volcanoes Best Investigated*

in Their Mildest Moods.—At the first recorded eruption of Vesuvius the elder Pliny lost his life in an attempt to approach the mountain and examine the action which was taking place there; and during the last great outburst of the same volcano a band of Neapolitan students, whose curiosity was greater than their prudence, shared the same fate.

But in both these cases the inquirers paid the penalty of having adopted a wrong method. If we wish to examine the mode of working of a complicated steam-engine, it will be of little avail for us to watch the machinery when the full blast of steam is turned on, and the rapid movements of levers, pinions, and slides baffle all attempts to follow them, and render hopeless every effort to trace their connection with one another. But if some friendly hand turn off the greater part of the steam-supply, then, as the rods move slowly backwards and forwards, as the wheels make their measured revolutions, and the valves are seen gradually opening and shutting, we may have an opportunity of determining the relations of the several parts of the machine to one another, and of arriving at just conclusions concerning the plan on which it is constructed.—JUDD *Volcanoes*, ch. 2, p. 7. (A., 1899.)

2091. MARVELOUS, THE, TRANSFORMED—*Newton's Discovery of the Laws of the Cometary Motions.*—In order to upset the theory of prodigies it was necessary to find the laws of the motion of comets. This is what Newton did in the case of the comet of 1680. Having ascertained that, according to the laws of universal gravitation, the path of the comet should be a very elongated curve, he attempted, assisted by Halley, his coadjutor and friend, to represent mathematically the course of the new body, and completely succeeded. Halley energetically took up this branch of astronomy, and finding later on that the comet of 1682 was similar in its path round the sun to two comets previously observed, in 1531 and 1607, recognized it as undoubtedly the same comet, which should, therefore, reappear about 1758.

By the theoretical labors of Newton and by the calculations of Halley the prediction of Seneca was fulfilled; comets, or at least some of them, follow regular orbits. Their return could be foreseen; they ceased to be accidental apparitions; they were true celestial bodies with a fixed and regular course. The marvelous disappeared, or, to speak more correctly, it was transformed. —FLAMMARION *Popular Astronomy*, bk. v, ch. 1, p. 485. (A.)

2092. MASS ENVELOPING HERCULANEUM AND POMPEII—*Rivers of Mud or Alluvium—Aqueous Lava.*—In addition to the ejections which fall on the cone, and that much greater mass which finds its way gradually to the neighboring sea, there is a third portion, often of no inconsiderable thickness, composed of alluviums, spread over the valleys and plains at small distances from the volcano. Aqueous vapors are evolved copiously from volcanic craters during eruptions, and often for a long time subsequently to the discharge of scoriæ and lava: these vapors are condensed in the cold atmosphere surrounding the high volcanic peak, and heavy rains are thus caused. The floods thus occasioned sweep along the impalpable dust and light scoriæ till a current of mud is produced, which is called in Campania "*lava d' acqua*," and is often more dreaded than an igneous stream (*lava di fuoco*), from the greater velocity with which it moves. So late as the 27th of October, 1822, one of these alluviums descended the cone of Vesuvius, and, after overspreading much cultivated soil, flowed suddenly into the villages of St. Sebastian and Massa, where, filling the streets and interior of some of the houses, it suffocated seven persons. It will, therefore, happen very frequently that, towards the base of a volcanic cone, alternations will be found of lava, alluvium, and showers of ashes.—LYELL *Principles of Geology*, bk. ii, ch. 24, p. 385. (A., 1854.)

2093. MASTERY, PROGRESSIVE, OF BODY BY MIND—The combined use of anesthetics and antiseptics has almost robbed the surgeon's knife of its terrors, and has enabled the most deeply seated organs to be laid open and operated upon with success. As a result, more lives are probably now saved by surgery than by any other branch of medicine.—WALLACE *The Wonderful Century*, ch. 14, p. 149. (D. M. & Co., 1899.)

2094. MATERIALISM AND IDEALISM —*Contrasted Claims—Possible Reconciliation.*—But when the materialists stray beyond the borders of their path and begin to talk about there being nothing else in the universe but matter and force and necessary laws, I decline to follow them. I go back to the point from which we started, and to the other path of Descartes. I remind you that we have already seen clearly and distinctly, and in a manner which admits of no doubt, that all our knowledge is a knowledge of states of consciousness. "Matter" and "force" are, so far as we can know, mere names for certain forms of consciousness. "Necessary" means that of which we cannot conceive the contrary. "Law" means a rule which we have always found to hold good, and which we expect always will hold good. Thus it is an indisputable truth that what we call the material world is only known to us under the forms of the ideal world: and, as Descartes tells us, our knowledge of the soul is more intimate and certain than our knowledge of the body. If I say that impenetrability is a property of matter, all that I can really mean is that the consciousness I call extension and the consciousness I call resistance constantly accompany one another. Why and how they

are thus related is a mystery. And if I say that thought is a property of matter, all that I can mean is that, actually or possibly, the consciousness of extension and that of resistance accompany all other sorts of consciousness. But, as in the former case, why they are thus associated is an insoluble mystery. From all this it follows that what I may term legitimate materialism, that is, the extension of the conceptions and of the methods of physical science to the highest as well as the lowest phenomena of vitality, is neither more nor less than a sort of shorthand idealism: and Descartes's two paths meet at the summit of the mountain, tho they set out on opposite sides of it.—HUXLEY *Lay Sermons*, serm. 14, p. 340. (G. P. P., 1899.)

2095. MATERIALISM A TENDENCY OF INDIVIDUAL MINDS—*Abstract Conceptions Personified as Living Powers.*—We can see how much and how little is really meant when it is said that law can be traced in all things, and all things can be traced to law. It is a great mistake to suppose that, in establishing this conclusion, the progress of modern investigation is in a direction tending to materialism. This may be and always has been the tendency of individual minds. There are men who would stare into the very burning bush without a thought that the ground on which they stand must be holy ground. It is not now of wood or stone that men make their idols, but of their own abstract conceptions. Before these, borrowing for them the attributes of personality, they bow down and worship.—ARGYLL *Reign of Law*, ch. 2, p. 67. (Burt.)

2096. MATERIALISM BAFFLED BY CONSCIOUSNESS—"You may say or think that this [assumed] issue of consciousness from the clash of atoms is not more incongruous than the flash of light from the union of oxygen and hydrogen. But I beg to say that it is. For such incongruity as the flash possesses is that which I now force upon your attention. The 'flash' is an affair of consciousness, the objective counterpart of which is a vibration. It is a flash only by your interpretation. You are the cause of the apparent incongruity; and you are the thing that puzzles me. . . .

"Your difficulty, then, as I see you are ready to admit, is quite as great as mine. You cannot satisfy the human understanding in its demand for logical continuity between molecular processes and the phenomena of consciousness. This is a rock on which materialism must inevitably split whenever it pretends to be a complete philosophy of life." [Supposed quotation from Bishop Butler.]—TYNDALL *Fragments of Science (the Belfast Address)*, vol. ii, ch. 9, p. 168. (A., 1900.)

2097. MATERIALISM CARRIED TO LOGICAL RESULT—*Personality Obliterated—Reductio ad Absurdum.*—To comprehend completely the consequences of the dogma so confidently enunciated, one should unflinchingly apply it to the most complicated examples. The movements of our tongues and pens, the flashings of our eyes in conversation, are of course events of a material order, and as such their causal antecedents must be exclusively material. If we knew thoroughly the nervous system of Shakespeare, and as thoroughly all his environing conditions, we should be able to show why at a certain period of his life his hand came to trace on certain sheets of paper those crabbed little black marks which we for shortness's sake call the manuscript of "Hamlet." We should understand the rationale of every erasure and alteration therein, and we should understand all this without in the slightest degree acknowledging the existence of the thoughts in Shakespeare's mind. The words and sentences would be taken, not as signs of anything beyond themselves, but as little outward facts, pure and simple. In like manner we might exhaustively write the biography of those two hundred pounds, more or less, of warmish albuminoid matter called Martin Luther, without ever implying that it felt.—JAMES *Psychology*, vol. i, ch. 5, p. 132. (H. H. & Co., 1899.)

2098. MATERIALISM CONFUSES THINGS ESSENTIALLY UNLIKE—*Voice, Man, and Brain Are Not the Thought.*—This equating of mental process and brain function, which makes psychology a department of cerebral physiology, and therefore a part of a general atomic mechanics, sins against the very first rule of scientific logic—that only those connections of facts may be regarded as causal which obtain between generically similar phenomena. Our feelings, thoughts, and volitions cannot be made objects of sensible perception. We can hear the word which expresses the thought, we can see the man who has thought it, we can dissect the brain in which it arose; but the word, the man, and the brain are not the thought. And the blood which circulates in the brain, the chemical changes which take place there, are wholly different from the act of thought itself.—WUNDT *Psychology*, lect. 1, p. 6. (Son. & Co., 1896.)

2099. MATERIALISM GIVES HYPOTHESES WITHOUT FACTS—*Brain Function and Mental Activity Connected—Mental Force Assimilated to Light or Electricity.*—There are numerous experiences which put beyond all doubt the connection of physiological cerebral function on the one hand and of mental activity on the other. And to investigate this connection by means of experiment and observation is assuredly a task worth undertaking. But we do not find that materialism, even in this connection, has made a single noteworthy contribution to our positive knowledge. It has been content to set up baseless hypotheses regarding the dependence of mental function upon physical process; or it has been concerned to refer the nature of mental forces to some known physical agency. No

analogy has been too halting, no hypothesis too visionary, for its purpose. It was for some time a matter of dispute whether the mental force had more resemblance to light or to electricity. Only on one point was there general agreement—that it was not ponderable.—WUNDT *Psychology*, lect. 1, p. 9. (Son. & Co., 1896.)

2100. MATERIALISM INCOMPREHENSIBLE — *Mechanical Evolution of Consciousness Not Presentable in Thought.*— This avowal is repeated with emphasis in the passage to which Professor Virchow's translator draws attention. What, I there ask, is the causal connection between the objective and the subjective—between molecular motions and states of consciousness? My answer is: I do not see the connection, nor am I acquainted with anybody who does. It is no explanation to say that the objective and subjective are two sides of one and the same phenomenon. Why should the phenomenon have two sides? This is the very core of the difficulty. There are plenty of molecular motions which do not exhibit this two-sidedness. Does water think or feel when it runs into frost-ferns upon a window pane? If not, why should the molecular motion of the brain be yoked to this mysterious companion—consciousness? We can form a coherent picture of all the purely physical processes—the stirring of the brain, the thrilling of the nerves, the discharging of the muscles, and all the subsequent motions of the organism. We are here dealing with mechanical problems which are mentally presentable. But we can form no picture of the process whereby consciousness emerges, either as a necessary link or as an accidental by-product of this series of actions.—TYNDALL *Fragments of Science*, vol. ii, ch. 15, p. 408. (A., 1900.)

2101. MATERIALISM MEANS PARALYSIS—There can be little doubt that the further science advances, the more extensively and consistently will all the phenomena of Nature be represented by materialistic formulæ and symbols. But the man of science, who, forgetting the limits of philosophical inquiry, slides from these formulæ and symbols into what is commonly understood by materialism, seems to me to place himself on a level with the mathematician who should mistake the *x*'s and *y*'s, with which he works his problems, for real entities—and with this further disadvantage, as compared with the mathematician, that the blunders of the latter are of no practical consequence, while the errors of systematic materialism may paralyze the energies and destroy the beauty of a life.—HUXLEY *The Physical Basis of Life*, in *Lay Sermons*, p. 146. (A., 1895.)

2102. MATERIALISM, TENDENCY TO—A large part of the age feels profound hatred for what is called spirit. Hence the effort to make man a brute and to lose his soul in matter.—LOTZE *An Address*. (Translated for *Scientific Side-Lights*.)

2103. MATERIALIST'S ANALOGY FALSE — *Thought Not a Secretion.* — The phosphorus philosophers have often compared thought to a secretion. "The brain secretes thought, as the kidneys secrete urine or as the liver secretes bile," are phrases which one sometimes hears. The lame analogy need hardly be pointed out. The materials which the brain *pours into the blood* (cholesterin, creatin, xanthin, or whatever they may be) are the analogues of the urine and the bile, being in fact real material excreta. As far as these matters go, the brain is a ductless gland. But we know of nothing connected with liver and kidney activity which can be in the remotest degree compared with the stream of thought that accompanies the brain's material secretions. —JAMES *Psychology*, vol. i, ch. 3, p. 102. (H. H. & Co., 1899.)

2104. MATERIALIST'S TRIUMPH— *Delight in the Mechanical and the Animal.*—The immense value of the theory of descent in regard to biology consists, as I have already remarked, in its explaining to us the origin of organic forms in a mechanical way, and pointing out their active causes. But however highly and justly this service of the theory of descent may be valued, yet it is almost eclipsed by the immense importance which a single necessary inference from it claims for itself alone. This necessary and unavoidable inference is the theory of the *animal descent of the human race.*

The determination of the position of man in Nature, and of his relations to the totality of things—this question of all questions for mankind, as Huxley justly calls it—is finally solved by the knowledge that man is descended from animals. As a consequence of the theory of descent or transmutation, we are now in a position to establish scientifically the groundwork of a *non-miraculous history of the development of the human race.*—HAECKEL *History of Creation*, vol. i, ch. 1, p. 6. (K. P. & Co., 1899.)

2105. MATERNITY FORESHADOWED—"*Mothering Plants*"—*The Phanerogams Highest in the Vegetable Kingdom.*— In the vegetable kingdom, from the motherlessness of the early cryptogams, we rise to find a first maternity foreshadowed in the flowering tree. It elaborates a seed or nut or fruit with infinite precaution, surrounding the embryo with coat after coat of protective substance, and storing around it the richest foods for its future use. And rudimentary tho the manifestation be, when we remember that this is not an incident in the tree's life, but its whole blossom and crown, it is impossible but to think of this solicitude and motherhood together. So exalted in the tree's life is this provision for others that the botanist, like the zoologist, places the mothering plants at the top of his department of Nature. His highest division is the phanerogams—named, liter-

ally, in terms of their reproductive specialization.—DRUMMOND *Ascent of Man*, ch. 8, p. 268. (J. P., 1900.)

2106. MATERNITY VS. MOTHERHOOD—*The Butterfly Cares for Its Egg—Does Not and Could Not Care for Its Young—Could Not Even Recognize It as Its Own.*—There is a solicitude for the egg of the most extreme kind—for its being placed exactly in the right spot, at the right time, protected from the weather, shielded from enemies, and provided with a first supply of food. The butterfly places the eggs of its young on the very leaves which the coming caterpillar likes the most, and on the under side of the leaf where they will be least exposed—a case which illustrates in a palpable way the essential difference between motherhood and maternity. Maternity here, in the restricted sense of merely adequate physical care, is carried to its utmost perfection. Everything that can be done for the egg is done. Motherhood, on the other hand, is non-existent, is even an anatomical impossibility If a butterfly could live till its egg was hatched—which does not happen—it would see no butterfly come out of the egg, no airy likeness of itself, but an earthbound caterpillar. If it recognized this creature as its child, it could never play the mother to it. The anatomical form is so different that were it starving it could not feed it, were it threatened it could not save it, nor is it possible to see any direction in which it could be of the slightest use to it. It is obvious that Nature never intended to make a mother here; that all that she desired as yet was to perfect the first maternal instinct. And the tragedy of the situation is that on that day when her training to be a true mother should begin she passes out of the world.—DRUMMOND *Ascent of Man*, ch. 8, p. 270. (J. P., 1900.)

2107. MATHEMATICS, BEAUTY OF—*In Music, Sunset, Snow-crystals—Harmony of Nature.*—The notes of the gamut are, besides, nothing else but ratios of number between the sonorous vibrations. Combined in a certain order, these numbers give perfect accord. Here the major mode rouses and enraptures us; there the minor mode affects us and plunges us into melancholy reverie. And yet there is here but a matter of figures! We can not only hear these sounds, but may even see them. Let us make two tuning-forks vibrate by the ingenious method of Lissajous, one vertical, the other horizontal, fitted with little mirrors reflecting a luminous point on a screen. If the two tuning-forks are in unison and give exactly the same note, the combination of the two vibrations rendered visible on the screen by the little mirrors, which inscribe them in lines of light, produces a perfect circle—that is to say, the simplest geometrical figure; as the amplitude of the vibrations diminishes, the circle flattens, becomes an ellipse, then a straight line. . . . Yes, in everything and everywhere numbers rule the world.

Why, however, seek in scientific analysis testimony to the harmony which Nature has shed over all her works? Altho it may be necessary for us to rise to the ideal of music, to contemplate the beautiful colors of the sky or the splendor of the setting sun, we may on a dull winter day, in the gray and monotonous hours when the snow falls in innumerable flakes, examine with the microscope some of these flakes, and the geometrical beauty of these light crystals will fill us with admiration. As Pythagoras said: "God works everywhere by geometry," ἀεὶ ὁ θεὸς γεωμετρεῖ.—FLAMMARION *Popular Astronomy*, bk. iii, ch. 1, pp. 223-26. (A.)

2108. MATHEMATICS, DEVELOPMENT OF—*Arithmetic Narrowly Limited before Decimal System.*—The Greeks, the Romans, the Egyptians, the Jews, and the Chinese had all such cumbrous systems that anything like a science of arithmetic, beyond very simple operations, was impossible; and the Roman system, by which the year 1888 would be written MDCCCLXXXVIII, was that in common use in Europe down to the fourteenth or fifteenth centuries, and even much later in some places. Algebra, which was invented by the Hindus, from whom also came the decimal notation, was not introduced into Europe till the thirteenth century, altho the Greeks had some acquaintance with it; and it reached Western Europe from Italy only in the sixteenth century. It was, no doubt, owing to the absence of a sound system of numeration that the mathematical talent of the Greeks was directed chiefly to geometry, in which science Euclid, Archimedes, and others made such brilliant discoveries. It is, however, during the last three centuries only that the civilized world appears to have become conscious of the possession of a marvelous faculty, . . . the full grandeur of which can be appreciated only by those who have devoted some time (even if unsuccessfully) to the study.—WALLACE *Darwinism*, ch. 15, p. 313. (Hum.)

2109. MATHEMATICS MINISTERS TO ALL SCIENCE—While the algebra of the Arabs, by means of that which they had acquired from the Greeks and Indians, combined with the portions due to their own invention, acted so beneficially on the brilliant epoch of the Italian mathematicians of the Middle Ages, notwithstanding a great deficiency in symbolical designations, we likewise owe to the same people the merit of having furthered the use of the Indian numerical system from Bagdad to Cordova by their writings and their extended commercial relations. Both these effects—the simultaneous diffusion of the knowledge of the science of numbers and of numerical symbols with value by position—have variously, but powerfully, favored the advance of the mathematical portion of natural sci-

ence, and facilitated access to the more abstruse departments of astronomy, optics, physical geography, and the theories of heat and magnetism, which, without such aids, would have remained unopened.—HUMBOLDT *Cosmos*, vol. ii, pt. ii, p. 227. (H., 1897.)

2110. MATHEMATICS OF THE UNIVERSE—*Full Realization Possible Only to the Divine Mind.*—But ascend with me above the dust, above the cloud, to the realms of the higher geometry, where the heavens are never obscured; where there is no impure vapor, and no delusive or imperfect observation; where the new truths are already arisen, while they are yet dimly dawning upon the earth below; where the earth is a little planet; where the sun has dwindled to a star; where all the stars are lost in the Milky Way, to which they belong; where the Milky Way is seen floating through space like any other nebula; where the whole great girdle of the nebulæ has diminished to an atom, and has become as readily and as completely submissive to the pen of the geometer, and the slave of his formula, as the single drop which falls from the cloud, instinct with all the forces of the material world. Try with me the precision of measure with which the universe has been meted out; observe how exactly all the parts are fitted to the whole and to each other, and then declare who was present in the council-chamber when the Lord laid the foundations of the earth.—BENJAMIN PIERCE *Address on retiring from the duties of President (Proceedings of Amer. Assoc. for Advancement of Science,* vol. viii, 1854, p. 2).

2111. MATHEMATICS ON WORD OF HONOR—*Story of the Duc d'Angoulême.*—I can hardly imitate here that Academician who, in order to prove a mathematical truth, was contented to give his word of honor because the intelligence of his pupil was not equal to comprehending the demonstration. This pupil was the Duke d'Angoulême, and I venture to hope that my readers are somewhat superior to him in that respect. We know that when he was nominated Chief Minister of Marine it was perceived with dismay that he could hardly count up to a hundred. The most celebrated geometer of France was at once sent for to instruct him in the mathematics, as they said in old times. But it was in vain that he tried to prove the most elementary principles to his august pupil. The latter listened with exquisite politeness, but shook his head with a mild air of incredulity. One day, at the end of the arguments, the poor master exclaimed, "My lord, I give you my word!" "Why did you not say so sooner, sir?" said the Duke, bowing: "I shall never permit myself to doubt it."—FLAMMARION *Popular Astronomy,* bk. v, ch. 2, p. 491. (A.)

2112. MATHEMATICS, POWER OF, IN ASTRONOMY—*Discovery of Neptune.*—It has been said, with reason, that the labors of astronomy are those which give the highest measure of the powers of the human mind. The discovery of Neptune, due to the sole power of numbers, is one of the most eloquent witnesses of this truth. The existence of this planet in the sky was revealed by mathematics. This world, distant more than 2,700 millions of miles from our terrestrial station, is absolutely invisible to the naked eye. The perturbations manifested by the motion of the planet Uranus permitted the mathematician to say that the cause of these perturbations was an unknown planet which revolved beyond Uranus at about such a distance, and which, to produce the effect observed, should be found at a certain point of the starry sky. A telescope was directed towards the point indicated, the unknown was searched for, and in less than an hour it was found!—FLAMMARION *Popular Astronomy,* bk. iv, ch. 9, p. 463. (A.)

2113. MATTER AND FORCE INFERIOR TO MIND—*Probability that Higher Attributes Exist in the Universe.*—No philosophy can be true which allows that we see in Nature the most intimate relations with our intellectual conceptions of space and time and force and numerical proportion, but denies that we can ever see any similar relation with our conceptions of purpose and design, or with those still higher conceptions which are embodied in our sense of justice and in our love of righteousness, and in our admiration of the "quality of mercy." These elements in the mind of man are not less certain than others to have some correlative in the mind which rules in Nature. Assuredly, in the supreme government of the universe these are not less likely than other parts of our mental constitution to have some part of the natural system related to them—so related that the knowledge of that system shall be at once their interpretation and fulfilment. Neither brute matter nor inanimate force can supply either the one or the other. If there be one truth more certain than another, one conclusion more securely founded than another, not on reason only, but on every other faculty of our nature, it is this—that there is nothing but mind that we can respect; nothing but heart that we can love, nothing but a perfect combination of the two that we can adore.—ARGYLL *Unity of Nature,* ch. 8, p. 184. (Burt.)

2114. MATTER AND MOTION—*Made by Descartes the Basis of All Phenomena of the Universe.*—Descartes saw that the discoveries of Galileo meant that the remotest parts of the universe were governed by mechanical laws, while those of Harvey meant that the same laws presided over the operations of that portion of the world which is nearest to us, namely, our own bodily frame. And crossing the interval between the center and its vast circumference by one of the great strides of genius, Descartes sought to resolve all the phenomena of the universe into matter and motion, or forces operating

according to law. This grand conception, which is sketched in the "Discours," and more fully developed in the "Principes" and in the "Traité de l'Homme," he worked out with extraordinary power and knowledge; and with the effect of arriving, in the last-named essay, at that purely mechanical view of vital phenomena towards which modern physiology is striving.—HUXLEY *Lay Sermons*, serm. 14, p. 331. (G. P. P., 1899.)

2115. MATTER, ATOMIC CONSTITUTION OF—*Hypothesis of Centers of Force—Phenomena Not So Explained.*—According to this celebrated hypothesis [the corpuscular hypothesis of Boscovich], a portion of matter consists of an assemblage in space of an indefinite number of points kept at a given distance by attracting and repelling forces: these points have relative position, but not magnitude, and are merely centers of action of the forces which affect our senses, and since all our knowledge of matter is derived from the action of these forces, to infer that these points are anything more than the centers of forces is going beyond our premises.

This hypothesis readily explains the statical properties of bodies, such as elasticity, porosity, impenetrability, solidity, liquidity, crystallization, resistance to compression when a force is applied to either side of the body, etc.; but it fails to account for the dynamic phenomena of masses of matter, or those which are referable to the three laws of motion. It is not therefore enough that we assume, as the elements of matter, an assemblage of points in space from which merely emanate attracting and repelling forces: we must also suppose these points to be endowed with inertia, or a tendency to resist a change of state, whether of rest or motion, and a tendency to move in a straight line; also to possess the property of preserving the effects of a number of impulses, as well as that of transforming motion from one point to another, the one losing as much motion as the other gains. But the admission of the existence of points with such qualities brings us back to the Newtonian hypothesis of matter.—HENRY *The Atomic Constitution of Matter, Scientific Writings*, vol. i, p. 256. (Sm. Inst., 1886.)

2116. ——— ——— *Hypothesis of Newton—One Kind of Matter throughout All Space—Its Four States—The Imponderables—Ether Cannot Exhibit Weight.*—We may assume, with Newton, the existence of one kind of matter diffused throughout all space, and existing in four states, namely, the ethereal, the aeriform, the liquid, and the solid. This method of presenting the atomic hypothesis of the constitution of matter may at first sight appear startling; but on a little reflection it will be found a necessary consequence of the attempt to explain the mechanical phenomena of matter by an assemblage of separate atoms. It may be objected to the assumption of one kind of matter that the fact of the imponderable nature of light, heat, electricity, and magnetism require at least two kinds of matter; but if we adopt the theory of undulation, the phenomena of the "imponderables" (as they are called) are merely the results of the motions of the atoms of the ethereal medium combined in some cases with the motion of the atoms of the body; and since the vibrations of the atoms of a mass of matter do not increase the attraction of the earth on the mass, an increase of temperature in a body cannot change its weight; and also because the ethereal medium fills all space, a portion of this medium can no more exhibit weight than a quantity of air when weighed in the midst of the atmosphere.—HENRY *Atomic Constitution of Matter, Scientific Writings*, vol. i, p. 257. (Sm. Inst., 1886.)

2117. ——— ——— *Materiality of Atoms—The Ether a Form of Matter, Filling All Space.*—According to the view we have given, a portion of matter consists of an assemblage of indivisible and indestructible atoms endowed with attracting and repelling forces, and with the property of obedience to the three laws of motion [viz.: inertia, coexistence of separate motions, and equality of action and reaction]. All the other properties, and indeed all the mechanical phenomena of matter, so far as they have been analyzed, are probably referable to the action of such atoms, arranged in groups of different orders, . . . the distance in all cases between any two atoms being much greater than the diameter of the atoms or molecules. We are obliged to assume the existence of an ethereal medium formed of atoms, which are endowed with precisely the same properties as those we have assigned to common matter; and this assumption leads us to the inference that matter is diffused through all space.

That something exists between us and the sun, possessing the properties of matter, may be inferred from the simple fact that time is required for the transmission of light and heat through the intervening space. . . . That the phenomena of light and heat from the sun are not the effect of the transmission of mere force (without intervening matter), such as that of attraction and repulsion, is evident from the fact that these [latter] actions require no perceptible time for their transmission to the most distant parts of the solar system. If the sun were to be at once annihilated, the planet Neptune would at the same instant begin to move in a tangent to its present orbit.—HENRY *The Atomic Constitution of Matter, Scientific Writings*, vol. i, p. 257. (Sm. Inst., 1886.)

2118. MATTER IN SPACE AND IN TIME—"There are only two different aspects," says Dr. Thomas Brown, "in which matter can be viewed. We may consider it

simply as it exists in space or as it exists in time. As it exists in space we inquire into its composition, or, in other words, endeavor to discover what are the elementary bodies that coexist in the space which it occupies; as it exists in time, we inquire into its susceptibilities or its powers, or, in other words, endeavor to trace all the various changes which have already passed over it, or of which it may yet become the subject."—MILLER *Old Red Sandstone*, ch. 12, p. 211. (G. & L., 1851.)

2119. MATTER, MORAL RELATIONS OF—*Man Communicates His Own Character—Use or Abuse of Material.*—Nothing, however indifferent in itself, can come into human hands without acquiring thereby an ethical, social, political, or even religious significance. An ounce of lead or a dynamite cartridge may be in itself a thing altogether destitute of any higher significance than that depending on physical properties; but let it pass into the power of man, and at once infinite possibilities of good and of evil cluster round it according to the use to which it may be applied. This depends on essential powers and attributes of man himself, of which he can no more be deprived than matter can be denuded of its inherent properties; and if the evils arising from misuse of these powers trouble us, we may at least console ourselves with the reflection that the possibility of such evils shows man to be a free agent, and not an automaton. All this is eminently applicable to science.—DAWSON *Facts and Fancies in Modern Science*, lect. 1, p. 12. (A. B. P. S.)

2120. MATTER, MUTABILITY OF—*Change Alone Is Constant.*—All things in existence are nothing but temporary phases of the transition of matter, appearing greater or smaller, of longer or shorter duration. Nothing but change is constant.—MERSHALL *(A Lecture)*. (Translated for *Scientific Side-Lights.)*

2121. MATTER RECOGNIZED BY RESISTANCE—*The Not-me—The Pull of Air on a Sail.*—We must, therefore, seek a satisfactory definition of matter elsewhere: and we find the clue to it in the consideration that the sense of effort we experience in antagonizing the downward pressure of a body, is but a particular case of our more general cognition of *resistance*. When we project our hand against a hard and fixed solid body, our consciousness of its resistance to our pressure is exactly that which we experience when we try to raise a weight that we have not strength to lift; whilst if that solid be either yielding in its parts or movable as a whole, we measure its resistance, as in lifting a weight, by our sense of the effort necessary to overcome it. When we move our hand through a liquid, we are conscious of a resistance to its motion, which is greater or less according to the "viscosity" of the liquid. And when we move our open hand through air at rest, we are still conscious of a resistance, our sense of it being augmented by an extension of the surface moved, as in the act of fanning; whilst if the air is in motion, we feel its pressure on the sail of a boat by the "pull" of the sheet we hold in our hand, or on the sails of a windmill by the rotation it imparts, the force of which we can estimate by the effort we must put forth to resist it. Attenuate any kind of air or gas as we may, its resistance can still be made apparent by the like communication of its own motion to solid bodies.—CARPENTER *Nature and Man*, lect. 12, p. 356. (A., 1889.)

2122. MAZE OF ASTEROIDAL ORBITS—*Labyrinth of the Heavens.*—The crowd of orbits [of asteroids] invites attentive study. D'Arrest remarked in 1851, when only thirteen minor planets were known, that supposing their paths to be represented by solid hoops, not one of the thirteen could be lifted from its place without bringing the others with it. The complexity of interwoven tracks thus illustrated has grown almost in the numerical proportion of discovery. Yet no two actually intersect, because no two lie exactly in the same plane, so that the chances of collision are at present *nil*. There is only one case, indeed, in which it seems to be eventually possible. M. Lespiault has pointed out that the curves traversed by "Fidès" and "Maïa" approach so closely that a time may arrive when the bodies in question will either coalesce or unite to form a binary system.

The maze threaded by the 375 asteroids contrasts singularly with the harmoniously ordered and rhythmically separated orbits of the larger planets. Yet the seeming confusion is not without a plan.—CLERKE *History of Astronomy*, pt. ii, ch. 8, p. 347. (Bl., 1893.)

2123. MEANING OF HISTORY—*Character and Achievement Transcend Psychology.*—Does history really mean for us what psychological and economical and statistical laws put in its place? Are "heroism and hero-worship" empty words? Have Kant and Fichte, Carlyle and Emerson, really nothing to say any more, and are Comte and Buckle our only apostles? Do we mean, in speaking of Napoleon and Washington, Newton and Goethe, those complicated chemical processes which the physiologist sees in their life, and those accompanying psychical processes which the psychologist enumerates between their birth and their death? Do we really still think historically if we consider the growth of the nations and this gigantic civilization on earth as the botanist studies the growth of the mold which covers a rotten apple? Is it really only a difference of complication?—MÜNSTERBERG *Psychology and Life*, ch. 1 p. 17. (H. M. & Co., 1899.)

2124. MEASURE OF ANCIENT GLACIER—*A Mountain for a Plummet.*—Mount Washington, for instance, is over six thousand feet high, and the rough, unpolished

surface of its summit, covered with loose fragments, just below the level of which glacier-marks come to an end, tells us that it lifted its head alone above the desolate waste of ice and snow. In this region, then, the thickness of the sheet cannot have been much less than six thousand feet, and this is in keeping with the same kind of evidence in other parts of the country; for, wherever the mountains are much below six thousand feet, the ice seems to have passed directly over them, while the few peaks rising to that height are left untouched. And while we can thus sink our plummet from the summit to the base of Mount Washington and measure the thickness of the mass of ice, we have a no less accurate indication of its extension in the undulating line marking the southern termination of the drift.—AGASSIZ *Geological Sketches*, ser. ii, p. 98. (H. M. & Co., 1896.)

2125. MEASURE OF THE POWER OF HEAT—It is singular how a modern investigator will repeat an experiment that dates almost from the dawn of human skill, and discover a significance in it concealed until the hour of his interrogation. Ages ago the savage must have remarked that the hard work of grinding and polishing stone gave rise to heat. It remained for James Prescott Joule, of Manchester, as recently as 1843, to carry forward by a decisive step the experiments which had begun with the savage and had been brought to a new meaning by Count Rumford. Joule set himself to find out exactly how much heat is equivalent to a given amount of work. He applied sinking weights to the agitation of water, and, taking elaborate precautions against the escape of heat, he found that 1,390 pounds in descending one foot could raise the temperature of a pound of water by 1° C. Here at last was rendered an accurate account of the enormous debt due to the ability to kindle fire.—ILES *Flame, Electricity, and the Camera*, ch. 7, p. 82. (D. & McC., 1900.)

2126. MEASUREMENT AMONG NORTH-AMERICAN MOUND-BUILDERS—*Exactness of Lines, Angles, and Circles.*—The squares or other rectangular works never have a ditch, and the earth of which they are composed appears to have been taken up evenly from the surface, or from large pits in the neighborhood. They vary much in size; five or six of them, however, are "exact squares, each side measuring one thousand and eighty feet—a coincidence which could not possibly be accidental, and which must possess some significance." The circles also, in spite of their great size, are so nearly round that the American archæologists consider themselves justified in concluding that the mound-builders must have had some standard of measurement, and some means of determining angles.—AVEBURY *Prehistoric Times*, ch. 8, p. 246. (A., 1900.)

2127. MEASUREMENT OF ENERGY—*The Foot-pound—Exactness of Science.*—This brings us to the discussion of what is called the "mechanical equivalent" of heat. It has been proven by experiment that the quantity of heat necessary to raise one pound of water to the temperature of one degree F. is equal to that generated by a pound weight falling from a height of 772 feet against the surface of the earth. Conversely, an amount of heat necessary to raise a pound of water one degree F. in temperature would, if all is converted into mechanical energy, be sufficient to raise a pound weight 772 feet above the earth. The unit of measurement called the "foot-pound" has been adopted as a means of determining the amount of energy expended in doing a given piece of work. The foot-pound is a unit of energy as expressed in work, and is that amount of energy which is necessary to raise one pound weight one foot high against the force of gravity. It follows from this that the amount of heat necessary to raise a pound of water one degree F. is equal to 772 foot-pounds, which constitutes the mechanical equivalent of heat. We thus have a means of measuring energy, whether mechanical or molecular.—ELISHA GRAY *Nature's Miracles*, vol. ii, ch. 1, p. 13. (F. H. & H., 1900.)

2128. MEASUREMENTS OF HEAT OF SUN—*Coal Needed for Equal Supply.*—The total amount of solar heat received by the earth in a year, if distributed uniformly over the earth's surface, would be sufficient to liquefy a layer of ice 100 feet thick, covering the whole earth. The heat of the sun, if used to melt a stratum of ice applied to the sun's surface, would liquefy it at the rate of 2,400 feet an hour. It would boil per hour 700,000 millions of cubic miles of ice-cold water. Expressed in another form, the heat given out every hour by the sun is equal to that which would be generated by the combustion of a layer of coal, ten feet thick, entirely surrounding the sun; hence the heat emitted in a year is equal to that which would be produced by the combustion of a layer of coal seventeen miles in thickness.—TYNDALL *Heat a Mode of Motion*, lect. 17, p. 516. (A., 1900.)

2129. MEASURES AMONG PRIMITIVE MEN—*The Human Body the Universal Standard.*—These ancient manufacturers and builders had no government standards of measuring their work, but referred everything to their bodies. This system was far more accurate among rude peoples, where anthropometric differences between the sexes and between individuals were very slight. Many witnesses confirm the opinion that every weapon or chungke-pole had its proportion to the owner. Dr. Mathews says that the Navajo pole for the great hoop game was twice the span long, and Mr. Dorsey found that the Omaha arrow had to measure from the inner angle of the elbow to the tip of the middle finger, and thence

over the back of the hand to the wrist bone. I have examined many hundreds of quivers, and have always found the arrows to be of the same length, while those of the tribe resemble in general appearance, but vary slightly in length for each man. Dr. Dorsey found the Naltunne, on Siletz Agency, in Oregon, using the double arm's length, the single arm's length, half the span, the cubit, the half-cubit, the hand-length, the hand-width, the finger-width, and from the tip of the elbow across the body to the end of the middle finger of the other hand. In most of these cases the starting-point is the meeting of the tips of the thumb and index-finger. . . .

Quite a series of measures were recognized from the ground to the upper portions of the body, to the ankle, to the upper portion of the calf, to the knee-cap, to the girdle, etc.—MASON *Aboriginal American Mechanics (Memoirs of the International Congress of Anthropology*, p. 77). (Sch. P. C.)

2130. MEASURES, ANCIENT — *The Human Body Furnished the Early Standards—The Cubit, Foot, Span, Nail, Ell, and Pace.*—It may be fairly guessed that man first measured, as he first counted, on his own body. When barbarians tried by finger-breadths how much one spear was longer than another, or when in building huts they saw how to put one foot before the other to get the distance right between two stakes, they had brought mensuration to its first stage. We sometimes use this method still for rough work, as in taking a horse's height by hands, or stepping out the size of a carpet. If care is taken to choose men of average size as measures, some approach may be made to fair measurement in this way. That it was the primitive way can hardly be doubted, for civilized nations who have more exact means still use the names of the body-measures. Besides the cubit, hand, foot, span, nail, . . . we have in English the ell (of which the early meaning of arm or forearm is seen in *el*-bow, the arm-bend), also the fathom or cord stretched by the outspread arms in sailors' fashion, and the pace or double step (Latin *passus*) of which a thousand *(mille)* made the mile.—TYLOR *Anthropology*, ch. 13, p. 316. (A., 1899.)

2131. MECHANIC MASTER OF THE EARTH— *Wonders Wrought by Command of Natural Forces.*—A mechanic is one who is skilled in the use of tools, who works habitually in some kind of material to shape it, who makes thereof something useful. He is, therefore, an artisan or artificer. He practises always some kind of elaborative industry, by which materials are changed in form to adapt them to the use of others. Finally, he is a utilitarian. His works are designed to supply some need. As distinguished from an artist, who works in order to give pleasure, this man toils to feed the hungry, to clothe the naked, to house the shelterless, to enable all mankind to do their work, whatever it may be. The modern mechanic is absolute master of the earth. There is little that he cannot lift, remove, dissolve, penetrate, transform. A catalog of his tools and appliances would define all the trades and industries of the world. All the material resources of the earth, mineral, vegetable, animal, are his. The winds, the waters, the fire, the sunlight, the lightning are his servants. He understands the nature and transformations of forces, the constitution and molecular activities of matter, the nature of living beings. He has devised means of multiplying himself, of converting space and time and weight, one into the other. And now he dreams of new applications of force and combines with his fellows to construct and govern society. The most favored nations have not always been so blest, but the mechanic, like every other product of Nature or of culture, is the result of many evolutions.—MASON *Aboriginal American Mechanics (Memoirs of International Congress of Anthropology*, p. 69). (Sch. P. C.)

2132. MECHANICS, A MONKEY'S COMPREHENSION OF — *Perseverance in Learning.*—To-day he [a brown capuchin monkey] obtained possession of a hearth-brush, one of the kind which has the handle screwed into the brush. He soon found the way to unscrew the handle, and having done that he immediately began to try to find out the way to screw it in again. This he in time accomplished. At first he put the wrong end of the handle into the hole, but turned it round and round the right way for screwing. Finding it did not hold, he turned the other end of the handle and carefully stuck it into the hole, and began again to turn it the right way. It was of course a very difficult feat for him to perform, for he required both his hands to hold the handle in the proper position and to turn it between his hands in order to screw it in, and the long bristles of the brush prevented it from remaining steady or with the right side up. He held the brush with his hind hand, but even so it was very difficult for him to get the first turn of the screw to fit into the thread; he worked at it, however, with the most unwearying perseverance until he got the first turn of the screw to catch, and he then quickly turned it round and round until it was screwed up to the end. The most remarkable thing was that, however often he was disappointed in the beginning, he never was induced to try turning the handle the wrong way; he always screwed it from right to left. As soon as he had accomplished his wish, he unscrewed it again, and then screwed it in again the second time rather more easily than the first, and so on many times. When he had become by practise tolerably perfect in screwing and unscrewing, he gave it up and took to some other amusement. One remarkable thing is that he should take so much trouble to do that which is no material benefit to

him. The desire to accomplish a chosen task seems a sufficient inducement to lead him to take any amount of trouble. This seems a very human feeling, such as is not shown, I believe, by any other animal. It is not the desire of praise, as he never notices people looking on; it is simply the desire to achieve an object for the sake of achieving an object, and he never rests nor allows his attention to be distracted until it is done.—ROMANES *Animal Intelligence (extract from diary of author's sister)*, ch. 17, p. 490. (A., 1899.)

2133. MECHANICS OF AMERICA BEFORE COLUMBUS—*Variety of Tools—A True Stone Age.*—The handy tools of our day do not change the mode of action, they do not add many new ideas out and out. They substitute better material, work more rapidly, and introduce cooperation in their actions. They are more often now driven by power rather than by hand. But the American mechanic before the days of Columbus had a respectable tool-chest, as his works will testify. The knives, shears, planes, axes, adzes, chisels, gouges, and saws of the aborigines of the Western Continent were of stone for the most part. The use of teeth, shell, and copper for such purposes was limited. Bronze may have sparingly entered into the list of cutting-tools among the advanced nations. For cutting, the Americans used both chipped and polished implements, and had a great variety of forms for working in hides or wood, or in ivory, antler, horn, slate, and such hard materials. These tools were best developed in the places where the best material abounded, such as British Columbia or the West Indies. . . . Mortars for paint, tobacco, and food, and metates for food and clay and chocolate, are to be found in all latitudes. From a hole in a natural boulder, in which an elongated pebble was worked, to the intricate California acorn-grinding apparatus, with its exquisite basketry hopper, or to a Mexican metate, tastefully carved, there are several grades of technical education, filled by the triturating and rubbing apparatus of other tribes. There were no mills in America four hundred years ago, turned either by man or beast. The grinding was done with metates and in mortars. For making holes, the implement of chief importance is universal, namely, a sharpened bone, used as a marlinespike, is employed by sailors. The skin-sewer and the basket-maker could not do without it, and hundreds of examples are found in their graves.—MASON *Aboriginal American Mechanics (Memoirs of International Congress of Anthropology*, p. 72). (Sch. P. C.)

2134. MEDITERRANEAN, ABYSSES OF—*Unsolved Problems of Science.*—The central abysses, therefore, of this sea [the Mediterranean] are, in all likelihood, at least as deep as the Alps are high; and, as at the depth of seven hundred fathoms only, water has been found to contain a proportion of salt four times greater than at the surface, we may presume that the excess of salt may be much greater at the depth of two or three miles. After evaporation, the surface-water becomes impregnated with a slight excess of salt, and, its specific gravity being thus increased, it instantly falls to the bottom, while lighter water rises to the top, or flows in laterally, being always supplied by rivers and the current from the Atlantic. The heavier fluid, when it arrives at the bottom, cannot stop if it can gain access to any lower part of the bed of the sea, not previously occupied by water of the same density.

How far this accumulation of brine can extend before the inferior strata of water will part with any of their salt, and what difference in such a chemical process the immense pressure of the incumbent ocean, or the escape of heated vapors, thermal springs, or submarine volcanic eruptions, might occasion, are questions which cannot be answered in the present state of science.—LYELL *Principles of Geology*, bk. ii, ch. 20, p. 336. (A., 1854.)

2135. MELODY AND MOTION UNITED—Many songsters in widely different families possess the habit of soaring and falling alternately while singing, and in some cases all the aerial postures and movements, the swift or slow descent, vertical, often with oscillations, or in a spiral, and sometimes with a succession of smooth oblique lapses, seem to have an admirable correspondence with the changing and falling voice—melody and motion being united in a more intimate and beautiful way than in the most perfect and poetic forms of human dancing.—HUDSON *Naturalist in La Plata*, ch. 19, p. 274. (C. & H., 1895.)

2136. MEMORY A MARVELOUS PHENOMENON — Remember! Have you ever reflected on the marvelous phenomenon we call memory? There is nothing we know better, nothing more familiar. There is no greater mystery. Every hour, every moment, external facts, scenes, utterances, physical sensations, ideas, and moral impressions are engraving themselves upon our minds and contributing to form the being which is ourself. Without memory we evidently should be nothing, for the present moment is continually vanishing, and we oscillate perpetually between the past and the future. It is our past that makes something of us, that imparts to us intellectual or moral value; every judgment we form presupposes memory.—BERSIER "*Souviens Toi*" *(a Sermon)*. (Translated for *Scientific Side-Lights.*)

2137. MEMORY A MYSTERY—*A Resurrection of the Buried Past.*—The mystery of memory lies in the apparent immediateness of the mind's contact with the vanished past. In "looking back" on our life, we seem to ourselves for the moment to rise above the limitations of time, to undo

its work of extinction, seizing again the realities which its on-rushing stream had borne far from us. Memory is a kind of resurrection of the buried past: as we fix our retrospective glance on it, it appears to start anew into life; forms arise within our minds which, we feel sure, must faithfully represent the things that were.—SULLY *Illusions*, ch. 10, p. 231. (A., 1897.)

2138. MEMORY AND THOUGHT—*Dependence of, on Bodily Condition—Evidence of Old Age, Delirium, and Sleep.*—The memory rises and falls with the bodily condition, being vigorous in our fresh moments, and feeble when we are fatigued or exhausted. It is related by Sir Henry Holland that on one occasion he descended, on the same day, two deep mines in the Hartz Mountains, remaining some hours in each. In the second mine he was so exhausted with inanition and fatigue that his memory utterly failed him; he could not recollect a single word of German. The power came back after taking food and wine. Old age notoriously impairs the memory in ninety-nine men out of a hundred. In the delirium of fever the sense of hearing sometimes becomes extraordinarily acute. Among the premonitory symptoms of brain disease has been noticed an unusual delicacy of the sense of sight; the physician suspects that there is already congestion of blood, to be followed perhaps by effusion. Any person fancying that trains of thinking have little dependence on the bodily organs should also reflect on such facts as these. When walking, or engaged in any bodily occupation, if an interesting idea occurs to the mind, or is imparted to us by another person, we suddenly stop, and remain at rest, until the excitement has subsided. . . . Why should sleep suspend all thought, except the incoherency of dreaming (absent in perfect sleep), if a certain condition of the bodily powers were not indispensable to the intellectual functions?—BAIN *Mind and Body*, ch. 2, p. 3. (Hum., 1880.)

2139. MEMORY, ANOMALIES OF—*Sudden Recollection of Something Sought in Vain.*—There are many irregularities in the process of forgetting which are as yet unaccounted for. A thing forgotten on one day will be remembered on the next. Something we have made the most strenuous efforts to recall, but all in vain, will, soon after we have given up the attempt, saunter into the mind, as Emerson somewhere says, as innocently as if it had never been sent for. Experiences of bygone date will revive after years of absolute oblivion, often as the result of some cerebral disease or accident which seems to develop latent paths of association, as the photographer's fluid develops the picture sleeping in the collodion film. The oftenest quoted of these cases is Coleridge's:

"In a Roman Catholic town in Germany, a young woman, who could neither read nor write, was seized with a fever, and was said by the priests to be possessed of a devil, because she was heard talking Latin, Greek, and Hebrew. Whole sheets of her ravings were written out, and found to consist of sentences intelligible in themselves, but having slight connection with each other. Of her Hebrew sayings, only a few could be traced to the Bible, and most seemed to be in the rabbinical dialect. All trick was out of the question; the woman was a simple creature; there was no doubt as to the fever. It was long before any explanation, save that of demoniacal possession, could be obtained. At last the mystery was unveiled by a physician, who determined to trace back the girl's history, and who, after much trouble, discovered that at the age of nine she had been charitably taken by an old Protestant pastor, a great Hebrew scholar, in whose house she lived till his death. On further inquiry it appeared to have been the old man's custom for years to walk up and down a passage of his house into which the kitchen opened, and to read to himself with a loud voice out of his books. The books were ransacked, and among them were found several of the Greek and Latin fathers, together with a collection of rabbinical writings. In these works so many of the passages taken down at the young woman's bedside were identified that there could be no reasonable doubt as to their source."—JAMES *Psychology*, vol. i, ch. 16, p. 681. (H. H. & Co., 1899.)

2140. MEMORY COEXTENSIVE WITH INTEREST—The attention which we lend to an experience is proportional to its vivid or interesting character; and it is a notorious fact that what interests us most vividly at the time is, other things equal, what we remember best. An impression may be so exciting emotionally as almost to leave a scar upon the cerebral tissues.—JAMES *Psychology*, vol. i, ch. 16, p. 670. (H. H. & Co., 1899.)

2141. MEMORY DEPENDS ON MULTIPLE ASSOCIATIONS—*Inherent Absurdity of Cramming System.*—You now see why "cramming" must be so poor a mode of study. Cramming seeks to stamp things in by intense application immediately before the ordeal. But a thing thus learned can form but few associations. On the other hand, the same thing recurring on different days, in different contexts, read, recited on, referred to again and again, related to other things and reviewed, gets well wrought into the mental structure. This is the reason why you should enforce on your pupils habits of continuous application. There is no moral turpitude in cramming. It would be the best, because the most economical, mode of study if it led to the results desired. But it does not, and your older pupils can readily be made to see the reason why.—JAMES *Talks to Teachers*, ch. 12, p. 129. (H. H. & Co., 1900.)

2142. MEMORY ESSENTIAL TO ALL MENTAL ACTION—*No Personal Identity, No Real Mind without Memory.*—Memory is the most important function of the brain; without it, life would be a blank. Our knowledge is all based on memory. Every thought, every action, our very conception of personal identity, is based on memory. Without memory, all experience would be useless; reasoning would be based on insufficient data, and would be, therefore, fallacious. A bad memory makes an otherwise able man appear foolish; he looks his acquaintances in the face without recognizing them; he forgets his appointments, and tho he may be well acquainted with the ordinary rules of society, he forgets what to do under particular circumstances. — ELDRIDGE-GREEN *Memory and Its Cultivation*, ch. 1, p. 1. (A., 1900.)

2143. MEMORY, FREAKS OF—*Retracing Links of Association.*—When a man tries to retrace some "train of thought" which has formerly passed through his mind, but of which he only remembers that the subject of it had been before him, he may often recover it by following it out (as it were) from the original starting-point; when the whole, with its conclusions, will often flash into the mind at once.

Thus, the writer well recollects that, when going to register the birth of one of his own children, he found, when approaching the office, that he had entirely forgotten the intended name, which had been decided on after a considerable amount of domestic discussion, and only brought it to his remembrance by "trying back" over the reasons which had determined the one finally selected.—CARPENTER *Mental Physiology*, ch. 10, p. 449. (A., 1900.)

2144. MEMORY, LAPSE OF—*Shock May Cause—Questions of Veracity May Be So Explained.*—Numerous cases are on record of a person receiving some great shock, and on recovery being found to have lost the memory not only of the circumstance which gave rise to the shock, but also of a certain period of time directly preceding it, all the events and circumstances which happened during that time being forgotten, the last circumstance remembered, preceding the blank, often being some trivial incident. . . . A young lady, having ascended an iron staircase, became giddy and fell down, being afterwards found insensible at the bottom. After her recovery, she had no recollection of the cause of her illness or the place where she had fallen down. Five years afterwards, she happened to go to the same place again and immediately the whole flashed into her mind; she remembered becoming giddy and falling.—ELDRIDGE-GREEN *Memory and Its Cultivation*, pt. i, ch. 3, pp. 20-22. (A., 1900.)

2145. ——— ——— *Work Forgotten by Author—Experience of Sir Walter Scott.*—One of the most curious examples of this limited loss of memory occurred in the case of Sir Walter Scott, who, having produced one of his best works ["The Bride of Lammermoor"] under the pressure of severe illness, was afterwards found to have entirely forgotten what he had thus constructed.

"The book (says James Ballantyne) was not only written, but published, before Mr. Scott was able to rise from his bed, and he assured me that when it was first put into his hands in a complete shape, he did not recollect one single incident, character, or conversation it contained! He did not desire me to understand, nor did I understand, that his illness had erased from his memory the original incidents of the story, with which he had been acquainted from his boyhood. These remained rooted where they had ever been; or, to speak more explicitly, he remembered the general facts of the existence of the father and mother, of the son and daughter, of the rival lovers, of the compulsory marriage, and the attack made by the bride upon the hapless bridegroom, with the general catastrophe of the whole. All these things he recollected, just as he did before he took to his bed; but he literally recollected nothing else—not a single character woven by the romancer, not one of the many scenes and points of humor, nor anything with which he was himself connected, as the writer of the work." ("Life of Walter Scott," ch. 44.) —CARPENTER *Mental Physiology*, ch. 10, p. 443. (A., 1900.)

2146. MEMORY, MENDACITY OF—*Experience Compels to Reluctant Doubt.*—Yet, altho people in general are naturally disposed to be very confident about matters of recollection, reflective persons are pretty sure to find out, sooner or later, that they occasionally fall into errors of memory. It is not the philosopher who first hints at the mendacity of memory, but the "plain man" who takes careful note of what really happens in the world of his personal experience. Thus we hear persons quite innocent of speculative doubt qualifying an assertion made on personal recollection by the proviso, "unless my memory has played me false." And even less reflective persons, including many who pride themselves on their excellent memory, will, when sorely pressed, make a grudging admission that they may, after all, be in error.—SULLY *Illusions*, ch. 10, p. 233. (A., 1897.)

2147. MEMORY OF TOTALS—*"A Woman's Reason."*—Students of any branch of practical science, medicine, botany, conchology, etc., soon find that they are able to recognize a specimen without going through the processes which were at first necessary to come to an opinion—that is, they "see it at a glance," as it is called. Now, if a person always revives a whole as a whole, and never splits it up into components, these components will never occur to his mind. . . . An example of this is found in what is called "woman's reason"—that is, she feels sure that a certain thing is so and so

"because it is"; thus a critic might feel utterly unable to say why a certain picture was a forgery, but feel perfectly sure in his own mind that it was not genuine, the reason being that the picture in question did not possess the whole of the qualities of one painted by ———, and so would not revive the requisite impression.—ELDRIDGE-GREEN *Memory and Its Cultivation,* pt. ii, p. 257. (A., 1900.)

2148. MEMORY, PECULIARITIES OF —*Seeming Anomalies—Psychology Seeks to Explain Conditions of Its Action.*—For why should this absolute God-given faculty [of memory] retain so much better the events of yesterday than those of last year, and, best of all, those of an hour ago? Why, again, in old age should its grasp of childhood's events seem firmest? Why should illness and exhaustion enfeeble it? Why should repeating an experience strengthen our recollection of it? Why should drugs, fevers, asphyxia, and excitement resuscitate things long since forgotten? If we content ourselves with merely affirming that the faculty of memory is so peculiarly constituted by Nature as to exhibit just these oddities, we seem little the better for having invoked it, for our explanation becomes as complicated as that of the crude facts with which we started. Moreover there is something grotesque and irrational in the supposition that the soul is equipped with elementary powers of such an ingeniously intricate sort. Why should our memory cling more easily to the near than the remote? Why should it lose its grasp of proper sooner than of abstract names? Such peculiarities seem quite fantastic; and might, for aught we can see a priori, be the precise opposites of what they are. Evidently, then, the faculty does not exist absolutely, but works under conditions; and the quest of the conditions becomes the psychologist's most interesting task.—JAMES *Psychology,* vol. i, ch. 1, p. 2. (H. H. & Co., 1899.)

2149. MEMORY, REVIVAL OF—*Childhood's Early Impression Recalled.*—[The following incident was personally mentioned to the writer by the subject of it:] Several years ago, the Rev. S. Hansard, now rector of Bethnal Green, was doing clerical duty for a time at Hurstmonceaux, in Sussex; and while there he one day went over with a party of friends to Pevensey Castle, which he did not remember to have ever previously visited. As he approached the gateway, he became conscious of a very vivid impression of having seen it before; and he "seemed to himself to see" not only the gateway itself, but donkeys beneath the arch, and people on the top of it. His conviction that he must have visited the castle on some former occasion—altho he had neither the slightest remembrance of such a visit, nor any knowledge of having ever been in the neighborhood previously to his residence at Hurstmonceaux—made him inquire from his mother if she could throw any light on the matter. She at once informed him that, being in that part of the country when he was about eighteen months old, she had gone over with a large party and had taken him in the pannier of a donkey; that the elders of the party, having brought lunch with them, had eaten it on the roof of the gateway where they would have been seen from below, whilst he had been left on the ground with the attendants and donkeys. This case is remarkable for the vividness of the sensorial impression (it may be worth mentioning that Mr. Hansard has a decidedly artistic temperament), and for the reproduction of details which were not likely to have been brought up in conversation, even if he had happened to hear the visit itself mentioned as an event of his childhood, and of such mention he has no remembrance whatever.—CARPENTER *Mental Physiology,* ch. 10, p. 430. (A., 1900.)

2150. MEMORY, UNCONSCIOUS—*Automatic Action Gains in Rapidity and Ease—Separate Volitions Involve Delay—Language and Music.*—The more sure and perfect, indeed, memory becomes, the more unconscious it becomes; and, when an idea or mental state has been completely organized, it is revived without consciousness, and takes its part automatically in our mental operations, just as an habitual movement does in our bodily activity. We perceive in operation here the same law of organization of conscious acquisitions as unconscious power which we observed in the functions of the lower nerve-centers. A child, while learning to speak or read, has to remember the meaning of each word, [and] must tediously exercise its memory: but which of us finds it necessary to remember the meanings of the common words which we are daily using, as we must do those of a foreign language with which we are not very familiar? We do remember them, of course, but it is by an unconscious memory. In like manner a pupil, learning to play the pianoforte, is obliged to call to mind each note: but the skilful player goes through no such process of conscious remembrance: his ideas, like his movements, are automatic, and both so rapid as to surpass the rapidity of succession of conscious ideas and movements.—MAUDSLEY *Body and Mind,* lect. 1, p. 25. (A., 1898.)

2151. MERMAID, ORIGIN OF FABLE OF—*The Dugong—Truth Underlying Fiction.*—In the time of Alexander the Great and afterwards under the Seleucidæ, the ancient Greeks became acquainted with the northwestern part of India. Then and there they heard many strange tales, which, as usual (especially when two different races and languages are concerned), lost nothing in the telling. Among other things, they heard that the seas about Ceylon were peopled with mermaids. In this case, as in the other case of so many other wonderful tales, there was a certain amount of truth underlying the fiction; for those seas are peopled by

creatures [the dugong] (as big or bigger than human beings), which have a habit of raising themselves up vertically out of the water, when they present a very startling appearance to an unscientifically critical eye. Astonished travelers beheld beings with rounded, human-looking heads, showing their body down to the bust out of the water, displaying a pair of rounded prominent breasts, and not seldom holding a baby in their arms. After remaining some time in this attitude, they would suddenly dive, and then a tail like a fish's became exposed to view. Small wonder, then, that sailors should imagine they were beholding creatures half woman and half fish, for the vivacity of a sailor's imagination is proverbial.—MIVART *Types of Animal Life*, ch. 11, p. 303. (L. B. & Co., 1893.)

2152. METAL USED AS STONE—*Transition from Stone to Bronze.*—On the whole, tho it would seem that they [the American Indians] sometimes at any rate softened the metal by heat, we have not, I think, at present any sufficient evidence that the redskins were acquainted with the art of casting. This is the more surprising because, as Schoolcraft tells us, " in almost all the works lately opened there are heaps of coals and ashes, showing that fire had much to do with their operations." Thus, tho they were acquainted with metal, they did not know how to use it; and, as Professor Dana has well observed in a letter with which he has favored me, they may in one sense be said to have been in an age of stone, since they used the copper, not as metal, but as stone. This intermediate condition between an age of stone and one of metal is most interesting.—AVEBURY *Prehistoric Times*, ch. 8, p. 210. (A., 1900.)

2153. METALS, COMBUSTIBLE—*Burning of Iron and Zinc.*—The rusting of iron is, to all intents and purposes, the slow burning of iron. It develops heat, and, if the heat be preserved, a high temperature may be thus attained. The destruction of the first Atlantic cable was probably due to heat developed in this way. Other metals are still more combustible than iron. You may light strips of zinc in a candle flame and cause them to burn almost like strips of paper.—TYNDALL *Lectures on Light*, lect. 1, p. 5. (A., 1898.)

2154. METALS, DIFFUSION OR FLOWING OF—*Gold Sinking into Copper—Old Coins Buried Increase in Purity.*—It is well known to the jeweler that articles of copper, plated with gold, lose their brilliancy after a time, and that it can be restored by boiling them in ammonia; this effect is probably produced by the ammonia acting on the copper, and dissolving off its surface so as to expose the gold, which, by diffusion, has entered into the copper.

A slow diffusion of one metal through another probably takes place in cases of alloys. Silver coins, after having lain long in the earth, have been found covered with a salt of copper. This may be explained by supposing that the alloy of copper, at the surface of the coin, enters into combination with the carbonic acid of the soil, and being thus removed, its place is supplied by a diffusion from within, and in this way it is not improbable that a considerable portion of the alloy may be exhausted in the process of time; and the purity of the coin be considerably increased.—HENRY *Capillarity of Metals, Scientific Writings*, p. 229. (Sm. Inst., 1886.)

2155. —— —— *Silver Sinking into Pores of Copper—Recovery by Acid—Man of Science Instructs "Practical" Workmen.*—[To test his theory of metals] he [Henry] inquired of Mr. Cornelius, of Philadelphia, if in the course of his experience in working silver-plated copper in his extensive manufactory of lamps he had ever observed the silver to disappear from the copper when the metal was heated. The answer was that the silver always disappears when the plate is heated above a certain temperature, leaving a surface of copper exposed; and that it was generally believed by the workmen that the silver evaporates at this temperature.

Professor Henry suggested that the silver, instead of evaporating, merely sunk into the pores of the copper, and that by carefully removing the surface of the latter, by the action of an acid the silver would reappear. To verify this by experiment, Mr. Cornelius heated one end of a piece of thick plated copper to nearly the melting-point of the metal; the silver at this end disappeared, and when the metal was cleaned by a solution of dilute sulfuric acid, the end which had been heated presented a uniform surface of copper, whilst the other end exhibited its proper coating of silver. The unsilvered end of the plate was next placed, for a few minutes, in a solution of muriate of zinc, by which the exterior surface of copper was removed, and the surface of silver was again exposed. This method of recovering the silver (before the process of plating silver by galvanism came into use) would have been of much value to manufacturers of plated ware, since it often happened that valuable articles were spoiled, in the process of soldering, by heating them to a degree at which silver disappears.—HENRY *Capillarity of Metals, Scientific Writings*, p. 228. (Sm. Inst., 1886.)

2156. METALS THE GIFT OF VOLCANOES—*Brought from Depths of Earth.*—But it is not only the finely crystallized minerals and gems which we owe to volcanic action. The various metallic minerals have nearly all been brought from deep-seated portions of the earth's crust and deposited upon the sides of rock-fissures by the agency of the same volcanic forces. It is these forces which have, in the first instance, opened the cracks through the solid rock-masses; and, in the second place, have brought the metallic sulfids, oxids, and

salts—either in fusion, in solution, or in a vaporized condition—from the deep-seated masses within the earth, causing them to crystallize upon the sides of the fissures, and thus form those metallic lodes and veins which are within reach of our mining operations.—JUDD *Volcanoes*, ch. 5, p. 149. (A., 1899.)

2157. METAPHOR CONVEYS ESSENTIAL TRUTH—*All Language Metaphorical—Adaptation Best Expressed in Terms of Design.*—For what purpose are metaphors used? Is it not as a means of making plain to our own understandings the principle of things, and of tracing amid the varieties of phenomena the essential unities of Nature? In this sense all language is full of metaphor, being, indeed, composed of little else. . . . Accordingly, when naturalists, describing plants or animals, use the language of contrivance to describe the adaptations of function, they must use it because they feel it to be a help in the understanding of the facts. When, for example, we are told that flowers are constructed in a peculiar manner "in order that" they may catch the proboscides of moths or the backs of bees, and that this adaptation, again, is necessary "in order that" these insects should carry the fertilizing pollen from flower to flower, nothing more may be immediately intended by the writer than that all this elaborate mechanism does as a matter of fact attain this end, and that it may be fitly described "as if" it had been arranged "in order that" these things might happen. But this use of language is none the less an acknowledgment of the truth that the facts of Nature are best brought home and explained to the understanding, and to the intelligence of man, by stating them in terms of the relation which they obviously bear to the familiar operations of our own mind and spirit.—ARGYLL *Unity of Nature*, ch. 8, p. 174. (Burt.)

2158. METAPHOR, LANGUAGE OF, A NECESSITY OF SCIENCE—*Natural Selection—Elective Affinity.*—Others have objected that the term "selection" implies conscious choice in the animals which become modified; and it has even been urged that, as plants have no volition, natural selection is not applicable to them! In the literal sense of the word, no doubt, "natural selection" is a false term; but who ever objected to chemists speaking of the "elective affinities" of the various elements?—and yet an acid cannot strictly be said to "elect" the base with which it in preference combines. It has been said that I speak of "natural selection" as an active power or deity; but who objects to an author speaking of the "attraction of gravity" as "ruling" the movements of the planets? Every one knows what is meant and is implied by such metaphorical expressions, and they are almost necessary for brevity. So, again, it is difficult to avoid personifying the word "Nature"; but I mean by "Nature" only the aggregate action and product of many natural laws, and by "laws" the sequence of events as ascertained by us. —DARWIN *Origin of Species*, ch. 4, p. 74. (Burt.)

2159. METAPHYSICS, BAD OR GOOD?—*Positivism Also Metaphysical.*—Scientific men are accustomed to reckon such laws as the first law of motion among the surest possessions of pure intellect, and the faculty by which they are conceived among the noblest proofs of its energy and power. Positivism, on the contrary, regards such laws as mere "artifices" of thought, and the power by which they are conceived not as a strength, but as an "infirmity" of mind. I do not deny that the process by which these abstractions are attained is a metaphysical process—that is to say, they are purely mental conceptions. But the process which denies "reality" to these conceptions is also purely a metaphysical process, with this only difference, that it is bad metaphysics instead of good.—ARGYLL *Reign of Law*, ch. 2, p. 67. (Burt.)

2160. METEORITES, CELESTIAL SPACES FULL OF—*Millions Fall on the Earth.*—We may now remark that these meteors play a much more important part than we were formerly disposed to believe. A single night, a single hour, a single minute, does not pass without the fall of a star. The terrestrial globe sails in the midst of a space full of diverse corpuscles circulating in all directions—some in elliptical streams of various inclinations, others even in the plane of the ecliptic, as we see by the zodiacal light which extends from the sun to beyond the terrestrial orbit. By enumerating the number of shooting stars which are seen above a given horizon during the different nights of the year, calculating the number of similar horizons which would comprise the whole surface of the globe, and taking into account the directions of the shooting stars, the monthly variations, etc., an eminent American astronomer, Mr. Simon Newcomb, has demonstrated that no fewer than one hundred and forty-six thousand millions (146,000,000,000) of shooting stars fall per annum on the earth.—FLAMMARION *Popular Astronomy*, bk. v, ch. 4, p. 535. (A.)

2161. METEORITES, THEIR FALL RECORDED IN ANCIENT TIMES—The Greek natural philosophers, who were but little disposed to pursue observations, but evinced inexhaustible fertility of imagination in giving the most various interpretation of half-perceived facts, have, however, left some hypotheses regarding shooting stars and meteoric stones which strikingly accord with the views now almost universally admitted of the cosmical process of these phenomena. "Falling stars," says Plutarch, in his life of Lysander, "are, according to the opinion of some physicists, not eruptions of the ethereal fire extin-

guished in the air immediately after its ignition, nor yet an inflammatory combustion of the air, which is dissolved in large quantities in the upper regions of space, but these meteors are rather a fall of celestial bodies, which, in consequence of a certain intermission in the rotatory force, and by the impulse of some irregular movement, have been hurled down not only to the inhabited portions of the earth, but also beyond it into the great ocean, where we cannot find them." Diogenes of Apollonia expresses himself still more explicitly. According to his views, " Stars that are invisible, and, consequently, have no name, move in space together with those that are visible. These invisible stars frequently fall to the earth and are extinguished, as the stony star which fell burning at Egos Potamos."—HUMBOLDT *Cosmos*, vol. i, p. 133. (H., 1897.)

2162. METEORS, FALL OF, UPON THE SUN—*Cannot Supply His Heat.*—Now we may assume with great probability that very many more meteors fall upon the sun than upon the earth, and with greater velocity, too, and therefore give more heat. Yet the hypothesis that the entire amount of the sun's heat which is continually lost by radiation is made up by the fall of meteors, a hypothesis which was propounded by Mayer, and has been favorably adopted by several other physicists, is open, according to Sir W. Thomson's investigations, to objection; for, assuming it to hold, the mass of the sun should increase so rapidly that the consequences would have shown themselves in the accelerated motion of the planets. The entire loss of heat from the sun cannot at all events be produced in this way; at the most a portion, which, however, may not be inconsiderable.—HELMHOLTZ *Popular Lectures*, lect. 4, p. 180. (L. G. & Co., 1898.)

2163. METEORS IN TRACK OF LOST COMET—To be lost is interesting, especially for a comet; but this, doubtless, was not enough, for it reserved for us a still more complete surprise. Its orbit intersects the terrestrial orbit at a point which the earth passes on November 27, 1872. Well, nothing more was thought about it; it was given up as hopeless, when, on the evening of November 27, 1872, there fell from the sky a veritable *rain of shooting stars.* The expression is not exaggerated; they fell in great flakes; lines of fire glided almost vertically in swarms and showers, here with dazzling globes of light, there with silent explosions recalling to mind those of rockets; and this rain lasted from seven o'clock in the evening till one o'clock next morning, the maximum being attained about nine o'clock. At the observatory of the Roman College 13,892 were counted; at Montealieri, 33,400; in England a single observer counted 10,579, etc. The total number has been estimated at a hundred and sixty thousand. They all came from the same point of the sky, situated near the beautiful star Gamma of Andromeda. . . . What was this shower of stars? Evidently—and this is not doubtful—the encounter with the earth of myriads of corpuscles moving in space along the orbit of Biela's comet. The comet itself, if it still existed, would have passed twelve weeks before. It was not, then, to speak correctly, the comet itself which we encountered, but perhaps a fraction of its decomposed parts, which, since the breaking-up of the comet in 1846, would be dispersed along its orbit behind the head of the comet.—FLAMMARION *Popular Astronomy*, bk. v, ch. 2, p. 500. (A.)

2164. METHOD, IMPORTANCE OF, IN PREPARATORY TRAINING—It does not matter so much what a scholar learns in the secondary school as how he learns. In other words, the method according to which the pupil is instructed and learns to think is decisive, as regards his preparatory training, of his capacity for future study.—ERDMANN *Ueber des Studium der Chemie*, p. 11. (Translated for *Scientific Side-Lights.*)

2165. METHOD OF ATTAINING SCIENTIFIC CONCLUSION—*Growth of Coral Only at Small Depths.*—The circumstance of a gradual change from a field of clean coral to a smooth sandy bottom is far more important in indicating the depth at which the larger kinds of coral flourish than almost any number of separate observations on the depth at which certain species have been dredged up. For we can understand the gradation only as a prolonged struggle against unfavorable conditions. If a person were to find the soil clothed with turf on the banks of a stream of water, but on going to some distance on one side of it he observed the blades of grass growing thinner and thinner with intervening patches of sand, until he entered a desert of sand, he would safely conclude, especially if changes of the same kind were noticed in other places, that the presence of the water was absolutely necessary to the formation of a thick bed of turf: so may we conclude, with the same feeling of certainty, that thick beds of coral are formed only at small depths beneath the surface of the sea.—DARWIN *Coral Reefs*, ch. 4, p. 111. (A., 1900.)

2166. METHOD OF SCIENCE VS. THAT OF RELIGION—In matters of science, light descends from the head to the heart; but in religion light ascends from the heart to the head. Only so far as we live in God can we understand him.—THOLUCK *Inscription in a Book.* (Translated for *Scientific Side-Lights.*)

2167. METHOD, THE VALUE OF—*Science Works to Definite Results.*—Two things are of particular remark in the discoveries in the Roman catacombs during the last thirty-eight years. First, they are the works of a single man; no one, this may be asserted, shares the fame of Giovanni

Battista de Rossi. And then, this is characteristic; accident has played no rôle here. They are the reward of science, conscious of its aim, well devised, according to definite rules. De Rossi never proceeds at random; he knows what he is doing, whither his way is leading, and always announces beforehand what he is going to find. Nothing illustrates better than the brilliant results of these excavations the value such labors derive from a good method.—MEYER *Die römischen Katakomben.* (Translated for *Scientific Side-Lights.)*

2168. MICROBES, INCONCEIVABLE MULTIPLICATION OF—*Death from Sting of a Fly.*—A man had died. Around the dead body, already disfigured, there was haste in order to withdraw from the living the spectacle of decomposition rapidly and profoundly taking place. Three days before, this man entered his home full of strength and of life, and a fly lighting upon his lip made an imperceptible prick—and behold, he was killed by a fly! No, the fly is a giant compared to what really produced this effect. It was the *bactéridée cherbonneuse* whose dipterous prick introduced the germ into the unfortunate victim. Two hours after the visit of the fly you might have counted two of these bacteria only in the blood of this man, four hours afterward it contained only four, six hours afterward, eight. The following day, when twenty-four hours had elapsed and he had banished from his mind all recollection of the unfortunate fly, he was still joyous and alert, but you might perhaps have clouded his gaiety by whispering in his ear that 4,996 of these bacteria were subsisting in his blood. You would have struck terror to his heart if the following day you had informed him that he now carried in his veins and arteries 16,000,000 of these germs. From the sixtieth to the seventy-second hour it would have been superfluous to try to comprehend that seventy-one milliards of bacteria had poisoned his vigorous constitution, and that by the seventy-fourth hour they had attained the enormous number of one hundred and forty-two milliards. . . . You are not surprised that the man was obliged to succumb. In fact there had taken place in his veins a magnificent struggle for which he was the stake.—COLTANCE *La Lutte pour l'Existence.* (Translated for *Scientific Side-Lights.)*

2169. MICRO-ORGANISMS FOSSIL IN CHALK—The slice of chalk presents a [very remarkable] appearance when placed under the microscope. The general mass of it is made up of very minute granules; but, embedded in this matrix, are innumerable bodies, some smaller and some larger, but, on a rough average, not more than a hundredth of an inch in diameter, having a well-defined shape and structure. A cubic inch of some specimens of chalk may contain hundreds of thousands of these bodies, compacted together with incalculable millions of the granules. . . . The chambered bodies are of various forms. One of the commonest is something like a badly grown raspberry, being formed of a number of nearly globular chambers of different sizes congregated together. It is called *Globigerina*, and some specimens of chalk consist of little else than *Globigerinæ* and granules. . . . It so happens that calcareous specimens exactly similar to the *Globigerinæ* of the chalk are being formed at the present moment by minute living creatures, which flourish in multitudes, literally more numerous than the sands of the seashore, over a large extent of that part of the earth's surface which is covered by the ocean.—HUXLEY *Lay Sermons*, serm. 9, pp. 178-180. (G. P. P., 1899.)

2170. MICRO-ORGANISMS FOUND LIVING IN OCEAN BED—In 1853, Lieutenant Brooke obtained mud from the bottom of the North Atlantic, between Newfoundland and the Azores, at a depth of more than 10,000 feet, or two miles, by the help of [his] sounding apparatus. The specimens were sent for examination to Ehrenberg, of Berlin, and to Bailey, of West Point, and those able microscopists found that this deep-sea mud was almost entirely composed of the skeletons of living organisms—the greater proportion of these being just like the *Globigerinæ* already known to occur in the chalk.—HUXLEY *Lay Sermons*, serm. 9, p. 181. (G. P. P., 1899.)

2171. MICROSCOPE, EARLY DISCOVERIES OF—*Fostered Belief in Spontaneous Generation.*—The discovery and improvement of the microscope, tho giving a death-blow to much that had been previously written and believed regarding spontaneous generation, brought also into view a world of life formed of individuals so minute—so close, as it seemed, to the ultimate particles of matter—as to suggest an easy passage from atoms to organisms. Animal and vegetable infusions exposed to the air were found clouded and crowded with creatures far beyond the reach of unaided vision, but perfectly visible to an eye strengthened by the microscope. With reference to their origin these organisms were called "Infusoria." Stagnant pools were found full of them, and the obvious difficulty of assigning a germinal origin to existences so minute furnished the precise condition necessary to give new play to the notion of heterogenesis or spontaneous generation.—TYNDALL *Fragments of Science*, vol. ii, ch. 13, p. 290. (A., 1900.)

2172. MICROSCOPE, SERVICE OF, TO SCIENCE—*Power of the Infinitely Little.*—As a matter of fact, there is no field of inquiry which has yielded such a large harvest to the truth-seeker of late years as that of microscopic research. There is scarcely a great discovery which has been made within the past decade in which our knowledge of the infinitely little, as shown forth by the microscope, has not figured most promi-

nently. Disease-germs and countless other lower forms of life have been traced out in their development and tracked to their origin. Living things, whose dimensions are to be estimated by the thousandth parts of inches, are as well known to us to-day as is the ostrich or the elephant. So far from the "little things" of the universe escaping our attention, I should be inclined to maintain that they largely monopolize science, to the exclusion of the big things. We are beginning to find out, in fact, that only by knowing something of the actions which proceed in the lower byways of life can existence in the main be understood at all.—ANDREW WILSON *Glimpses of Nature*, ch. 25, p. 80. (Hum., 1892.)

2173. MIGRATION, IRRATIONAL— *Blind Instinct of Progression of Lemmings.*—The lemming of Norway is a sort of vole, very celebrated on account of its sudden and marvelous migrations. When a conjuncture of favorable circumstances enables them to multiply to an enormous extent a migratory instinct becomes developed in them, whereby they are led to descend to lower-lying lands than those they normally frequent. They migrate slowly and intermittently, journeying only by night, and increasing frequently as they go. Their journey may last for three years before they reach the seacoast, according to the route they may happen to have followed. When they reach the coast they go on into the sea and so perish. As they journey along they are preyed upon by bears, wolves, foxes, dogs, wildcats, weasels, eagles, hawks, and owls. They are also destroyed by man, and even domestic animals, such as goats and reindeer, will spring upon and kill them. Numbers also die of disease, but they never turn back—they proceed ever onwards to their ultimate destination.—MIVART *Types of Animal Life*, ch. 12, p. 356. (L. B. & Co., 1893.)

2174. MIGRATION OF BIRDS, EXTENT OF—*Subsistence an Important Factor—Change of Diet of Non-migratory Birds.*—The extent of a bird's migration is, in most cases, dependent upon the nature of its food. Birds that are resident in one place throughout the year generally change their fare with the season, and apparently feed with equal relish on seeds or insects. Those that are dependent upon fruit must migrate far enough to find a supply of berries, while the insect-eaters are obliged to travel even farther south. Most of the migratory birds of our Western States pass the winter in Mexico. Our Eastern sparrows and our berry-eaters, like the robin and bluebird, winter from the Middle States to the Gulf coast, while the majority of our purely insectivorous species cross to Cuba and winter in the West Indies, or continue to Central America and even northern South America. Snipe and plover make the most extended migrations, some species breeding within the arctic circle and wintering along the coasts of Patagonia.—CHAPMAN *Bird-Life*, ch. 4, p. 49. (A., 1900.)

2175. MIGRATION OF PLANTS— *The Struggle for Life Lessened—Cross-fertilization Secured.*—The various devices by which plants are shifted from place to place are not merely to extend and multiply the species and reach a fertile soil, but to enable them to flee from the great number of their own kind and from their enemies among animals and parasitic plants. The adventurers among plants often meet with the best success, not because the seeds are larger, or stronger, or better, but because they find, for a time, more congenial surroundings. We must not overlook the fact, so well established, that one of the greatest points to be gained by plant migration is to enable different stocks of a species to be cross-fertilized, and thereby improved in vigor and productiveness.—BEAL *Seed Dispersal*, ch. 9, p. 85. (G. & Co., 1898.)

2176. MILDNESS OF THE EUROPEAN CLIMATE—*Heated Air from Tropics Descending.*—Gradually, however, as the upper stream, which rises from the equator and flows towards the poles, becomes chilled and dense, it sinks towards the earth; at the Peak of Teneriffe it has already sunk below the summit of the mountain. With the contrary wind blowing at the base, the traveler often finds the wind from the equator blowing strongly over the top. Farther north the equatorial wind sinks lower still, and finally reaches the surface of the earth. Europe, for the most part, is overflowed by this equatorial current. Here, in London, for eight or nine months in the year, southwesterly winds prevail. But mark what an influence this must have upon our climate. The moisture of the equatorial ocean comes to us endowed with potential energy; it comes, if you prefer the language, charged with latent heat. In our atmosphere condensation takes place, and the heat liberated is a main source of warmth to our climate. Were it not for the rotation of the earth we should have over us the hot, dry blasts of Africa; but, owing to this rotation, the wind which starts northward from the Gulf of Mexico is deflected to Europe. Europe is, therefore, the recipient of those stores of latent heat which were amassed in the western Atlantic. The British Isles come in for the greatest share of this moisture and heat, and this circumstance adds itself to that already dwelt upon—the high specific heat of water—to preserve our climate from extremes.—TYNDALL *Heat a Mode of Motion*, lect. 8, p. 212. (A., 1900.)

2177. MILK NORMALLY STERILE —*Can Be So Drawn—Yet Commonly Infested with Bacteria—Cleanliness the First Great Need.*—There are few liquids in general use which contain such enormous numbers of germs as milk. To begin with, milk

is in every physical way admirably adapted to be a favorable medium for bacteria. It is constituted of all the chief elements of the food upon which bacteria live. It is frequently at a temperature favorable to their growth. It is *par excellence* an absorptive fluid. . . . Yet, whilst this general fact is true, we must emphasize at the outset the possibility and practicability of securing absolutely pure sterile milk. Recently some milking was carried out under strict antiseptic precautions, with the above sterile result. The udder was thoroughly cleansed, the hands of the milker washed with corrosive sublimate and then pure water, the vessels which were to receive the milk had been carefully sterilized, and the whole process was carried out in strict cleanliness. The result was that the sample of milk remained sweet and good and contained no germs. It should be stated that the first flow of milk, washing out the milk-ducts of the udder, was rejected. This fact of the sterility of cleanly drawn milk is not a new one, and has been established by many bacteriologists. Milk, then, is normally a sterile secretion.—NEWMAN *Bacteria*, ch. 6, p. 180. (G. P. P., 1899.)

2178. MIMICRY, PROTECTIVE—*Brilliant, Inedible Moths Mimicked by Others.*—[A showy] protected group in the Eastern tropics is that of the beautiful day-flying moths forming the family *Agaristidæ*. These are usually adorned with the most brilliant colors or conspicuous markings, they fly slowly in forests among the butterflies and other diurnal insects, and their great abundance sufficiently indicates their possession of some distastefulness which saves them from attack. Under these conditions we may expect to find other moths which are not so protected imitating them, and this is the case. One of the common and wide-ranging species *(Ophthalmis lincea)*, found in the islands from Amboyna to New Ireland, is mimicked in a wonderful manner by one of the *Liparidæ*. . . . Both insects are black, with the apex of the fore wings ocher-colored, and the outer half of the hind wings bright orange.—WALLACE *Darwinism*, ch. 9, p. 167. (Hum.)

2179. ——— *Colors of Grouse and Ptarmigan.*—The close imitation in the plumage of these birds [the grouse and ptarmigan of Scotland] of the general tinting and mottling of the ground on which they lie and feed is apparent at a glance, and is best known to those who have tried to see grouse or ptarmigan when sitting, and when their position is indicated within a few feet or a few inches by the trembling nostrils and dilated eyeballs of a steady pointer dog. In the case of the common grouse, as the ground is nearly uniform in color throughout the year, the coloring of the bird is constant also. But in the case of the ptarmigan, it changes with the changing seasons. The pearly grays, which in summer match so exactly with the lichens of the mountain peaks, give place in winter to the pure white which matches not less perfectly with the wreaths of snow.—ARGYLL *Reign of Law*, ch. 4, p. 110. (Burt.)

2180. ——— *Dependent on Will—Moth Purposely Folds in His Brilliant Wings.*—There are some forms of mimicry which are wholly independent of any action on the part of the animals themselves, and this kind of mimicry is especially common in this class of insects. They are often made of the shape and of the color which are most like those of the surrounding objects in their habitat. They have nothing to do except to sit still, or perhaps to crouch. But there are other forms of mimicry in which the completeness of the deception depends on some cooperation of the animal's own will. This [the sudden disappearance of a brilliant Italian moth, apparently transformed into a withered leaf] was one of these. The splendid margins of the upper wings, with the peculiar shape and their shining color, had to be concealed; and so, by an effort which evidently required the exertion of special muscles, these margins were somehow folded down—reverted—covered up, and thus hidden out of sight. The remainder of the wings, or the under-surfaces which were now made uppermost, were so colored and so crumpled up that they imitated exactly the dried and withered leaves around.—ARGYLL *Unity of Nature*, ch. 3, p. 52. (Burt.)

2181. ——— *Grasshopper Resembling Wasp.*—A [special] case of mimicry not yet noticed by any naturalist is seen in [a species of] grasshopper common in La Plata *(Rhomalea speciosa*, of Thunberg). This is an extremely elegant insect: the head and thorax chocolate, with cream-colored markings; the abdomen steel-blue or purple, a color I have not seen in any other insects of this family. The fore wings have a protective coloring; the hind wings are bright red. When at rest, with the red and purple tints concealed, it is only a very pretty grasshopper, but the instant it takes wing it becomes the facsimile of a very common wasp of the genus *Pepris*. These wasps vary greatly in size, some being as large as the hornet; they are solitary, and feed on the honey of flowers and on fruit, and, besides being furnished with stings like other wasps—though their sting is not so venomous as in other genera—they also, when angry, emit a most abominable odor, and are thus doubly protected against their enemies. Their excessive tameness, slow flight, and indolent motions serve to show that they are not accustomed to be interfered with. All these strong-smelling wasps have steel-blue or purple bodies and bright red wings. So exactly does the *Rhomalea* grasshopper mimic the *Pepris* when flying that I have been deceived scores of times. I have even seen it on the leaves, and after

it has flown and settled once more I have gone to look at it again, to make sure that my eyes had not deceived me.—HUDSON *Naturalist in La Plata*, ch. 8, p. 127. (C. & H., 1895.)

2182. ——— ——— *Leaf-insects—Stick-insect.*—The well-known leaf-insects of Ceylon and of Java, species of *Phyllium*, are so wonderfully colored and veined, with leafy expansions on the legs and thorax, that not one person in ten can see them when resting on the food-plant close beneath their eyes. Others resemble pieces of stick with all the minutiæ of knots and branches, formed by the insects' legs, which are stuck out rigidly and unsymmetrically. I have often been unable to distinguish between one of these insects and a real piece of stick till I satisfied myself by touching it and found it to be alive.—WALLACE *Darwinism*, ch. 8, p. 138. (Hum.)

2183. ——— ——— *Sand-colored Lizard of Seashore.*—Of lizards there were many kinds, but only one (*Proctotretus multimaculatus*) remarkable from its habits. It lives on the bare sand near the seacoast, and from its mottled color, the brownish scales being speckled with white, yellowish red, and dirty blue, can hardly be distinguished from the surrounding surface. When frightened, it attempts to avoid discovery by feigning death, with outstretched legs, depressed body, and closed eyes; if further molested, it buries itself with great quickness in the loose sand. This lizard, from its flattened body and short legs, cannot run quickly. — DARWIN *Naturalist's Voyage around the World*, ch. 5, p. 97. (A., 1898.)

2184. ——— ——— *Stick-insect—Fly and Humblebee.*—The stick-insect is, perhaps, the most perfect example where resemblance to an inanimate object has been the result aimed at, so to speak, by Nature; the resemblance of the volucella fly to the humblebee, on which it is parasitical, is the most familiar example of one species growing like another to its own advantage, since only by means of its deceptive likeness to the humblebee is it able to penetrate into the nest with impunity.—HUDSON *Naturalist in La Plata*, ch. 8, p. 127. (C. & H., 1895.)

2185. MIND AND BODY, ON EARTH INSEPARABLE—*Magnetism and the Needle.*—In such a question as the connection of mind and body the potent method of removing the cause is not applicable. We cannot dissect the compound, man, into body apart and mind apart; we cannot remove mind so as to see if the body will vanish. We may remove the body, and in so doing we find that mind has disappeared; but the experiment is not conclusive: for in removing the body we remove our indicator of the mind, namely, the bodily manifestations—as if in testing for magnetism we should set aside the needle and other tokens of its presence.—BAIN *Mind and Body*, ch. 3, p. 5. (Hum., 1880.)

2186. MIND AND BRAIN — *Mental Power Not Measured by Size of Brain—Increase of Intellectual Force Geometrical.*—Comparing the increasing size of the brain with the increase in mental power, we are struck with the smallness of the one increase as compared with the other. An ordinary male human brain is 48 oz.; the brains of extraordinary men seldom reach Cuvier's figure, 64 oz. Now the intellectual force of the ordinary man is surpassed by Cuvier in a far higher ratio than this. Taking the mere memory, which is the basis of intellect, an ordinary man could not retain one-third or one-fourth, perhaps not one-tenth, of the facts stored up in the mind of a Cuvier. The comparison of animals with human beings would sustain a similar inference. There would be no exaggeration in saying that while size of brain increases in arithmetical proportion, intellectual range increases in geometrical proportion.—BAIN *Mind and Body*, ch. 3, p. 6. (Hum., 1880.)

2187. MIND AND MATTER, ALLIANCE OF—*Thought, Incapable of Extension, Allied with Extended Matter—Contrast and Mystery.*—This, then, as it appears to me, is the only real difficulty of the physical and mental relationship. There is an *alliance with matter*, with the object, or extended world; but the thing allied, the *mind proper*, has itself no extension, and cannot be joined in local union. Now, we have a difficulty in providing any form of language, any familiar analogy, suited to this unique conjunction; in comparison with all ordinary unions, it is a paradox or a contradiction. We understand union in the sense of local connection; here is a union where local connection is irrelevant, unsuitable, contradictory; for we cannot think of mind without putting ourselves out of the world of place. When, as in pure feeling—pleasure or pain—we change from the object attitude to the subject attitude we have undergone a change not to be expressed by place; the fact is not properly described by the transition from the *external* to the *internal*, for that is still a change in the region of the extended. The only adequate expression is a *change of state*: a change from the state of the extended cognition to a state of unextended cognition. By various theologians heaven has been spoken of as not a place, but a *state;* and this is the only phrase that I can find suitable to describe the vast tho familiar and easy transition from the material or extended to the immaterial or unextended side of our being.—BAIN *Mind and Body*, ch. 6, p. 34. (Hum., 1880.)

2188. MIND AND NATURE, INTERACTION OF—*Progress from Effect to Cause, Thence to New Effect.*—Our senses stand between these phenomena and the reasoning mind. We observe the fact, but are not satisfied with the mere act of observation; the fact must be accounted for—fitted into its position in the line of cause and effect.

Taking our facts from Nature, we transfer them to the domain of thought: look at them, compare them, observe their mutual relations and connections, and bringing them ever clearer before the mental eye, finally alight upon the cause which unites them. This is the last act of the mind, in this centripetal direction—in its progress from the multiplicity of facts to the central cause on which they depend. But, having guessed the cause, we are not yet contented. We set out from the center and travel in the other direction. If the guess be true, certain consequences must follow from it, and we appeal to the law and testimony of experiment whether the thing is so. Thus is the circuit of thought completed—from without inward, from multiplicity to unity, and from within outward, from unity to multiplicity.—TYNDALL *Fragments of Science*, ch. 11, p. 282. (A., 1897.)

2189. MIND, AN OBJECT OF SCIENTIFIC STUDY—*Improved Treatment of Insanity—Intelligent Investigation of Nervous Disease.*—The habit of viewing mind as an intangible entity or incorporeal essence, which science inherited from theology, prevented men from subjecting its phenomena to the same method of investigation as other natural phenomena: its disorders were thought to be an incomprehensible affliction and, in accordance with the theological notion, due to the presence of an evil spirit in the sufferer, or to the enslavement of the soul by sin, or to anything but their true cause—bodily disease. Consequently, the treatment of the insane was not in the hands of intelligent physicians, who aimed to apply the resources of medicine to the alleviation or cure of bodily illness, but was given up to coarse and ignorant jailers, whose savage cruelties will for all time to come be a great and ugly blot upon the enlightenment of the age which tolerated them. Matters are happily changed now. On all hands it is admitted that the manifestations of mind take place through the nervous system, and that its derangements are the result of nervous disease, amenable to the same method of investigation as other nervous diseases. Insanity has accordingly become a strictly medical study, and its treatment a branch of medical practise. Still, it is all too true that, notwithstanding we know much and are day by day learning more of the physiology of the nervous system, we are only on the threshold of the study of it as an instrument subserving mental function.—MAUDSLEY *Body and Mind*, lect. 1, p. 12. (A., 1898.)

2190. MIND A PART OF NATURE—*Mental Laws Are also Natural Laws.*—If the mind is so spoken of and represented as to suggest the idea of something apart from the general system of Nature, and if its laws of thought are looked upon as "forms" or molds into which, by some artificial arrangement or by some mechanical necessity, everything from outside must be squeezed and made to fit, then it will naturally occur to us to doubt whether conceptions cut out and manufactured under such conditions can be any trustworthy representation of the truth. Such, unfortunately, has been the mode of representation adopted by many philosophers, and such, accordingly, has been the result of their teaching. This is the great source of error in every form of the idealistic philosophy, but it is a source of error which can be perfectly eliminated, leaving untouched and undoubted the large body of truths which has made that philosophy attractive to so many powerful minds.—ARGYLL *Unity of Nature*, ch. 4, p. 89. (Burt.)

2191. MIND CONSCIOUS OF ITS OWN LIMITATIONS—*Limits of Opportunity Rather than of Power—Appetite Can Be Satisfied, but Mind or Spirit Cannot.*—Nothing, certainly, in the human mind is more wonderful than this—that it is conscious of its own limitations. For it is to be observed that such consciousness would be impossible if these limitations were in their nature absolute. The bars which we feel so much, and against which we so often beat in vain, are bars which could not be felt at all unless there were something in us which seeks a wider scope. It is as if these bars were a limit of opportunity rather than a boundary of power. No absolute limitation of mental faculty ever is, or ever could be, felt by the creatures whom it affects. Of this we have abundant evidence in the lower animals, and in those lower faculties of our own nature which are of like kind to theirs. Our bodily appetites can seek nothing beyond or beside the objects of their desire. To the attainment of these objects that desire is limited, and with this attainment it is satisfied. Moreover, when a bodily appetite is satisfied, it for the time ceases to exist, and may even be converted into nausea and disgust towards that which had been the object of pursuit. This is the necessary effect of a limitation which is absolute. But the case is very different with the appetites of the mind, and still more with the cravings of the spirit. Even in the purest physical investigations we are perpetually encountering some mental barrier through which we cannot break and over which we cannot see. And yet we know it and feel it to be a barrier and nothing more. We stop in front of it not because we are satisfied, but because it bars our way.—ARGYLL *Unity of Nature*, ch. 4, p. 76. (Burt.)

2192. MIND CONTROLLING BODY—*Confident Belief an Aid to Recovery.*—Perhaps we do not, as physicians, consider sufficiently the influence of mental states in the production of disease, and their importance as symptoms, or take all the advantage which we might take of them in our efforts to cure it. Quackery seems to have here got hold of a truth which legitimate

medicine fails to appreciate and use adequately. Assuredly the most successful physician is he who, inspiring the greatest confidence in his remedies, strengthens and exalts the imagination of his patient: if he orders a few drops of peppermint-water with the confident air of curing the disease, will he not really do more sometimes for the patient than one who treats him in the most approved scientific way, but without inspiring a conviction of recovery? Ceremonies, charms, gesticulations, amulets, and the like have in all ages and among all nations been greatly esteemed and largely used in the treatment of disease; and it may be speciously presumed that they have derived their power, not from any contract with the supernatural, but, as Bacon observes, by strengthening and exalting the imagination of him who used them. Entirely ignorant as we are, and probably ever shall be, of the nature of mind, groping feebly for the laws of its operation, we certainly cannot venture to set bounds to its power over those intimate and insensible molecular movements which are the basis of all our visible bodily functions, any more than we can justly venture to set bounds to its action in the vast and ever progressing evolution of Nature, of which all our thoughts and works are but a part.—MAUDSLEY *Body and Mind*, lect. 1, p. 38. (A., 1898.)

2193. MIND DOMINATED BY PRECONCEIVED IDEA—*Misreading of Words.*—A tendency to read a particular meaning into a word may lead to the misapprehension of the word. To give an illustration: I was lately reading the fifth volume of G. H. Lewes's "Problems of Life and Mind." In reading the first sentence of one of the sections, I again and again fell into the error of taking "The great Lagrange" for "The great Language." On glancing back I saw that the section was headed "On Language," and I at once recognized the cause of my error in the preexistence in my mind of the representative image of the word "language."—SULLY *Illusions*, ch. 9, p. 228. (A., 1897.)

2194. MIND INFINITELY VARIED—*Mental Qualities of Ants.*—Does it not seem as if Nature wants to play with our judgment by the variety and superiority of conceptions of which she offers an example, in the details as well as in the whole? We can only judge according to known facts, but Nature never imitates herself and has no need to imitate. The fecundity of understanding that has dictated these laws is not known to possess limits: each species has its habits, each individual its peculiar constitution. That is why we fall into errors without number, why our observations cause us to deviate in deciding which rules appear the most general. [This is observable in the case of] the ants, whose history furnishes so many examples of the insufficiency of our conjectures.—HUBER *Recherches sur les Mœurs des Fourmis indigènes*, p. 102. (Translated for *Scientific Side-Lights.*)

2195. MIND, IS IT LIMITED TO BRAIN?—*Intelligence in Reflex Movements.*—Is the brain the exclusive organ of mind? If it be so, to what category of functions shall we refer the reflex acts of the spinal cord, which take place independently of the brain, and which often achieve as definite an end, and seem to display as intelligent an aim, as any conscious act of volition?—MAUDSLEY *Body and Mind*, lect. 1, p. 15. (A., 1898.)

2196. MIND, LIMITATIONS OF—*Artistic and Scientific Genius Not Conjoined—Mastery in One Line Compatible with Ability in Many.*—A great mind may be great in many things, because the same kind of power may have numerous applications. The scientific mind of a high order is also the practical mind; it is the essence of reason in every mode of its manifestation—the true philosopher in conduct as well as in knowledge. On such a mind also a certain amount of artistic culture may be superinduced; its powers of acquisition may be extended so far. But the spontaneous, exuberant, imaginative flow, the artistic nature at the core, never was, cannot be, included in the same individual. Aristotle could not be also a tragic poet, nor Newton a third-rate portrait-painter. The cost of one of the two modes of intellectual greatness is all that can be borne by the most largely endowed personality; any appearances to the contrary are hollow and delusive.—BAIN app. to *Conservation of Energy* by STEWART, p. 431. (Hum., 1880.)

2197. MIND, LIMITS OF, UNKNOWN—*Worms Seeming to Exceed Ants in Intelligence.*—As worms are not guided by special instincts in each particular case, tho possessing a general instinct to plug up their burrows, and as chance is excluded, the next most probable conclusion seems to be that they try in many different ways to draw in objects, and at last succeed in some one way. But it is surprising that an animal so low in the scale as a worm should have the capacity for acting in this manner, as many higher animals have no such capacity. For instance, ants may be seen vainly trying to drag an object transversely to their course, which could be easily drawn longitudinally; tho after a time they generally act in a wiser manner.—DARWIN *Formation of Vegetable Mould*, ch. 2, p. 26. (Hum., 1887.)

2198. MIND, LITTLE DEVELOPMENT OF, WITHOUT SPEECH—*The Greatness of Mind Is Due to the Tongue.*—It is not too much to say that speech, if mental evolution is to come to anything or is to be worth anything, is a necessary condition. By it alone, in any degree worth naming, can the fruits of observation and experience of one generation be husbanded to form a new starting-point for a second, nor without it could there be any concerted action or social life. The greatness of the human mind,

after all, is due to the tongue, the material instrument of reason, and to language, the outward expression of the inner life.—DRUMMOND *Ascent of Man*, ch. 4, p. 152. (J. P., 1900.)

2199. MIND MUST BE TRAINED TO SOUND THINKING—*Science Cultivates Orderly Habits of Thought.*—The system of mind-gymnastics is one which is imperative on all ages and conditions. In no age can its advantages be more thoroughly understood than in this controversial epoch, when the oldest and most respected of ideas are ruthlessly deposed from their niches, and supplanted by new and advanced codes of opinion. To have our young trained to "think," and our elders to judiciously weigh and consider all the matters of life; to teach men and women how to use their reason; to enable them successfully to grapple with the great difficulties of trade and labor, of science and art, of morality and religion—such are the objects which this system of mind-training has in view. And the study of natural science accomplishes these great ends chiefly by inducing orderly habits of thought. The very essence of this study lies in the cultivation of the observant faculties, and in the true culture of the senses to appreciate, and, through appreciation, to understand and enjoy the objects which are set before the mind.—ANDREW WILSON *Science-Culture for the Masses*, p. 27. (Hum., 1888.)

2200. MIND, MYSTERIES OF, REVEALED IN MUSIC—It has always struck me as a mystery peculiarly interesting and wonderful that in the theory of music, in the physical and technical foundations of this art, which above all others seems to create in the mind the most immaterial, evanescent, and tender states of consciousness, incalculable and indescribable, that especially in this, the science of purest and strictest thought — mathematics — should prove itself preeminently productive. Thorough-bass is a kind of applied mathematics. As for musical intervals, divisions of time, and so forth, numerical fractions and even at times logarithms play a prominent part. Mathematics and music—the most glaring opposites possible in human thought! And yet they are connected, mutually sustained. It is as if they would demonstrate that hidden consensus of all activities of our mind which in the revelations of genius enables us to forefeel the unconscious utterances of an intelligence mysteriously active.—HELMHOLTZ *On the Physiological Causes of Harmony in Music (Popular Scientific Lectures*, p. 63.) (Translated for *Scientific Side-Lights.)*

2201. MIND NOT DEGRADED BY ASSOCIATION WITH THE ANIMAL BODY—*Electricity Not Materialized by Passing through Metal.*—So godlike a gift is intellect, so wondrous a thing is consciousness, that to link them with the animal world seems to trifle with the profoundest distinctions in the universe. Yet to associate these supersensuous things with the animal kingdom is not to identify them with the animal body. Electricity is linked with metal rods; it is not, therefore, metallic.—DRUMMOND *Ascent of Man*, ch. 4, p. 20. (J. P., 1900.)

2202. MIND OF MAN AND BEAST—*Resemblance in Action Indicates Mental Likeness—Monkeys and Children.*—At the Zoological Gardens one may sometimes see a handful of nuts divided between the monkeys inside the bars and the children outside, and it is instructive to notice how nearly both go through the same set of movements, looking, approaching, elbowing, grasping, cracking, munching, swallowing, holding out their hands for more. Up to this level the monkeys show all the mental likeness to man that their bodily likeness would lead us to expect. . . . The boy knows a nut by sight, wishes to renew the pleasant taste of former nuts, and directs his hands and mouth to grasp, crack, and eat. But here are complicated mental processes. Knowing a nut by sight, or having an idea of a nut, means that there are grouped together in the child's mind memories of a number of past sensations, which have so become connected by experience that a particular form and color, feel and weight, lead to the expectation of a particular flavor. Of what here takes place in the boy's mind we can judge, tho by no means clearly, from what we know about our own thoughts and what others have told us about theirs. What takes place in the monkeys' minds we can only guess by watching their actions, but these are so like the human as to be most readily explained by considering their brain-work also to be like the human, tho less clear and perfect. It seems as tho a beast's idea or thought of an object may be, as our own, a group of remembered sensations compacted into a whole.—TYLOR *Anthropology*, ch. 2, p. 48. (A., 1899.)

2203. MIND OF OBSERVER DETERMINES HIS VIEW OF NATURE—It may seem a rash attempt to endeavor to separate into its different elements the magic power exercised upon our minds by the physical world, since the character of the landscape and of every imposing scene in Nature depends so materially upon the mutual relation of the ideas and sentiments simultaneously excited in the mind of the observer. The powerful effect exercised by Nature springs, as it were, from the connection and unity of the impressions and emotions produced; and we can only trace their different sources by analyzing the individuality of objects and the diversity of forces. The richest and most varied elements for pursuing an analysis of this nature present themselves to the eyes of the traveler in the scenery of Southern Asia, in the Great Indian Archipelago, and more es-

pecially, too, in the New Continent, where the summits of the lofty Cordilleras penetrate the confines of the aerial ocean surrounding our globe, and where the same subterranean forces that once raised these mountain chains still shake them to their foundation and threaten their downfall.—HUMBOLDT *Cosmos*, vol. i, int., p. 27. (H., 1897.)

2204. MIND OVERWHELMED BY VAST PERIODS OF TIME—The chief cause of our natural unwillingness to admit that one species has given birth to other and distinct species is that we are always slow in admitting great changes of which we do not see the steps. The difficulty is the same as that felt by so many geologists, when Lyell first insisted that long lines of inland cliffs had been formed and great valleys excavated by the agencies which we still see at work. The mind cannot possibly grasp the full meaning of the term of even a million years; it cannot add up and perceive the full effects of many slight variations, accumulated during an almost infinite number of generations.—DARWIN *Origin of Species*, ch. 15, p. 497. (Burt.)

2205. MIND PREFERS CONCRETE TO ABSTRACT—I can consider the hand, the eye, the nose, each by itself abstracted or separated from the rest of the body. But then, whatever hand or eye I imagine, it must have some particular shape and color. Likewise the idea of man that I frame to myself must be either of a white, or a black, or a tawny, a straight, or a crooked, a tall, or a low, or a middle-sized man. I cannot by any effort of thought conceive the abstract idea above described. And it is equally impossible for me to form the abstract idea of motion distinct from the body moving, and which is neither swift nor slow, curvilinear nor rectilinear; and the like may be said of all other abstract general ideas whatsoever.—BERKELEY *Principles of Human Knowledge*, int., p. 178. (L., 1874.)

2206. MIND READILY REPRODUCES FAMILIAR IMPRESSIONS—*In Artist's Few Lines Spectator Sees the Face—Hence Ready Illusion.*—Another great fact that has come to light in the investigation of these illusions is that oft-recurring and familiar types of experience leave permanent dispositions in the mind. What has been frequently perceived is perceived more and more readily. It follows from this that the mind will be habitually disposed to form the corresponding mental images, and to interpret impressions by help of these. The range of artistic suggestion depends on this. A clever draftsman can indicate a face by a few rough touches, and this is due to the fact that the spectator's mind is so familiarized, through recurring experience and special interest, with the object, that it is ready to construct the requisite mental image at the slightest external suggestion. And hence the risk of hasty and illusory interpretation.—SULLY *Illusions*, ch. 5, p. 91. (A., 1897.)

2207. MIND REVEALED THROUGH MATTER—*Care of Body Important—Oxygen Ministers to Mental and Spiritual Life.*—Mind, like force, is known to us only through matter. Take, then, what hypothesis you will—consider matter as an instrument through which the insulated mind exercises its powers, or consider both as so inextricably mixed that they stand or fall together; from both points of view the care of the body is equally important. The morality of clean blood ought to be one of the best lessons taught us by our pastors and masters. The physical is the substratum of the spiritual, and this fact ought to give to the food we eat and to the air we breathe a transcendental significance. Boldly and truly writes Mr. Ruskin, "Whenever you throw your window wide open in the morning, you let in Athena, as wisdom and fresh air at the same instant; and whenever you draw a pure, long, full breath of right heaven, you take Athena into your heart, through your blood, and with the blood into thoughts of the brain." No higher value than this could be assigned to atmospheric oxygen.—TYNDALL *Hours of Exercise in the Alps*, ch. 25, p. 301. (A., 1898.)

2208. MIND, THE EVOLUTION OF—*Illustrated in a Savage—An Incalculable Creature to Civilized Man.*—No one should pronounce upon the evolution of mind till he has seen a savage. By this is not meant the show savage of an Australian town, or the quay Kafir of a South-African port, or the Reservation Indian of a Western State; but the savage as he is in reality, and as he may be seen to-day by any who care to look upon so weird a spectacle. No study from the life can compare with this in interest or in pathos, nor stir so many strange emotions in the mind of a thoughtful man. To sit with this incalculable creature in the heart of the great forest; to live with him in his natural home as the guest of Nature, to watch his ways and moods and try to resolve the ceaseless mystery of his thoughts—this, whether the existing savage represents the primitive savage or not, is to open one of the workshops of creation and behold the half-finished product from which humanity has been evolved.—DRUMMOND *Ascent of Man*, p. 142. (J. P., 1900.)

2209. MIND, THE MECHANICAL THEORY OF—*Ideas Like Bricks of the Structure.*—An influential school of psychology, seeking to avoid haziness of outline, has tried to make things appear more exact and scientific by making the analysis more sharp. The various fields of consciousness, according to this school, result from a definite number of perfectly definite elementary mental states, mechanically associated into a mosaic or chemically combined. According to some thinkers—Spencer, for example,

or Taine—these resolve themselves at last into little elementary psychic particles or atoms of "mind-stuff," out of which all the more immediately known mental states are said to be built up. Locke introduced this theory in a somewhat vague form. Simple "ideas" of sensation and reflection, as he called them, were for him the bricks of which our mental architecture is built up. . . . Whether it be true or false, it is at any rate only conjectural; and, for practical purposes, the more unpretending conception of the stream of consciousness, with its total waves or fields incessantly changing, will amply suffice.—JAMES *Talks to Teachers*, ch. 2, p. 19. (H. H. & Co., 1900.)

2210. MIND UNLIKE THE HUMAN UNKNOWN TO THE HUMAN—If it can be said with truth that "the universal mind is essentially other than the human mind," so that no recognizable relations can exist between them, then that universal mind is to us as if it were not.—ARGYLL *Reign of Law*, ch. 2, p. 63. (Burt.)

2211. MIND, UNTRAINED, PREFERS THE MARVELOUS TO THE TRUE—*Wonderful and Terrible Agencies Excite Superstition.*—It is not difficult to understand how false notions on the subject of volcanic action have come to be so generally prevalent. In the earlier stages of its development, the human mind is much more congenially employed in drinking in that which is marvelous than in searching for that which is true. It must be admitted, too, that the grand and striking phenomena displayed by volcanoes are especially calculated to inspire terror and to excite superstition, and such feelings must operate in preventing those close and accurate observations which alone can form the basis of scientific reasoning.—JUDD *Volcanoes*, ch. 1, p. 2. (A., 1899.)

2212. MIND WELL FURNISHED IS CAPABLE OF SUSTAINED ATTENTION—We can see why it is that what is called sustained attention is the easier, the richer in acquisitions and the fresher and more original the mind. In such minds, subjects bud and sprout and grow. At every moment, they please by a new consequence and rivet the attention afresh. But an intellect unfurnished with materials, stagnant, unoriginal, will hardly be likely to consider any subject long. A glance exhausts its possibilities of interest. Geniuses are commonly believed to excel other men in their power of sustained attention. In most of them, it is to be feared, the so-called "power" is of the passive sort. Their ideas coruscate, every subject branches infinitely before their fertile minds, and so for hours they may be rapt.—JAMES *Psychology*, vol. i, ch. 11, p. 423. (H. H. & Co., 1899.)

2213. MINERALS HELD INVISIBLE IN WATER—*Calcareous Substances Deposited by Boiling—Opposite Results of a Single Process.*—Spring-water and river-water that have passed through or over considerable distances in calcareous districts suffer change in boiling. The origin and nature of this change may be shown by an experiment as follows: Buy a pennyworth of lime-water from a druggist and procure a small glass tube of about quill size, or the stem of a fresh tobacco-pipe may be used. Half fill a small wine-glass with the lime-water, and blow through it by means of the tube or tobacco-pipe. Presently it will become turbid. Continue the blowing, and the turbidity will increase up to a certain degree of milkiness. Go on blowing with "commendable perseverance," and an inversion of effect will follow; the turbidity diminishes, and at last the water becomes clear again.

The chemistry of this is simple enough. From the lungs a mixture of nitrogen, oxygen, and carbonic acid is exhaled. The carbonic acid combines with the soluble lime, and forms a carbonate of lime, which is insoluble in mere water. But this carbonate of lime is to a certain extent soluble in water saturated with carbonic acid, and such saturation is effected by the continuation of blowing.

Take some lime-water that has been thus treated, place it in a clean glass flask, and boil it. After a short time the flask will be found incrusted with a thin film of something. This is the carbonate of lime which has been thrown down again by the action of boiling, which has driven off its solvent, the carbonic acid. This crust will effervesce if a little acid is added to it.—WILLIAMS *Chemistry of Cookery*, ch. 2, p. 10. (A., 1900.)

2214. MINERALS OF VESUVIUS—A great variety of minerals are found in the lavas of Vesuvius and Somma: augite, leucite, feldspar, mica, olivin, and sulfur are most abundant. It is an extraordinary fact that in an area of three square miles round Vesuvius a greater number of simple minerals have been found than in any spot of the same dimensions on the surface of the globe. Haüy enumerated only 380 species of simple minerals as known to him; and no less than eighty-two had been found on Vesuvius and in the tuffs on the flanks of Somma before the end of the year 1828. Many of these are peculiar to that locality. Some mineralogists have conjectured that the greater part of these were not of Vesuvian origin, but thrown up in fragments from some older formation, through which the gaseous explosions burst. But none of the older rocks in Italy or elsewhere contain such an assemblage of mineral products; and the hypothesis seems to have been prompted by a disinclination to admit that, in times so recent in the earth's history, the laboratory of Nature could have been so prolific in the creation of new and rare compounds. Had Vesuvius been a volcano of high antiquity, formed when Nature

> **Wanton'd as in her prime, and play'd at will**
> **Her virgin fancies,**

it would have been readily admitted that these, or a much greater variety of substances, had been sublimed in the crevices of lava, just as several new earthy and metallic compounds are known to have been produced by fumaroles, since the eruption of 1822.—LYELL *Principles of Geology*, bk. ii, ch. 24, p. 385. (A., 1854.)

2215. MINES, ANCIENT—*Trees of Great Age Growing on Excavated Earth.*—[A group of mining-works of very great antiquity] appears to have been first discovered in 1847 by Mr. Knapp, the agent of the Minnesota Mining Company. His observations have "brought to light ancient excavations of great extent, frequently from twenty-five to thirty feet deep, and scattered over an area of several miles. He counted three hundred and ninety-five annular rings on a hemlock-tree which grew on one of the mounds of earth thrown out of an ancient mine. Mr. Foster also notes the great size and age of a pine stump, which must have grown, flourished, and died since the works were deserted; and Mr. C. Whittesley not only refers to living trees upwards of three hundred years old, now flourishing in the gathered soil of the abandoned trenches, but adds, 'On the same spot there are the decayed trunks of a preceding generation or generations of trees that have arrived at maturity and fallen down from old age.'"—AVEBURY *Prehistoric Times*, ch. 8, p. 247. (A., 1900.)

2216. MINUTENESS INCONCEIVABLE—*Dimensions of Waves of Light—Microscopic Infinity.*—Whether, however, there are such things as waves of ether or not, there is something concerned in the phenomena of light which has definite dimensions, that have been measured with as much accuracy as the dimensions of astronomy, altho they are at the opposite extreme of the scale of magnitude. We represent these dimensions to our imagination as wave-lengths, that is, as the distances from crest to crest of our assumed ether-waves, and we shall find it difficult to think clearly upon the subject without the aid of this wave theory, and every student of physics will bear me out in the statement that, tho our theory may be a fantom of our scientific dreaming, these magnitudes must be the dimensions of something. Here they are:

Dimensions of Light-waves.

COLORS.	Number of waves in one inch.	Number of oscillations in one second.
Red	39,000	477,000,000,000,000
Orange	42,000	506,000,000,000,000
Yellow	44,000	535,000,000,000,000
Green	47,000	577,000,000,000,000
Blue	51,000	622,000,000,000,000
Indigo	54,000	658,000,000,000,000
Violet	57,000	689,000,000,000,000

. . . These values always create a smile with a popular audience, which makes it evident that, by those unfamiliar with the subject, they are looked upon as unreal, if not absurd. But this is a prejudice. In our universe the very small is as real as the very great; and if science in astronomy can measure distances so great that this same swift messenger, light, traveling 192,000 miles a second, requires years to cross them, we need not be surprised that, at the other end of the scale, it can measure magnitudes like these.—COOKE *New Chemistry*, lect. 1, p. 15. (A., 1899.)

2217. MIRACLE AN EXERCISE OF SUPERHUMAN POWER—Locke [in his "Discourse on Miracles"] recognizes the great truth that we can never know what is above Nature unless we know all that is within Nature. But he misses another truth, quite as important, that a miracle would still be a miracle even tho we did know the laws through which it was accomplished, provided those laws, tho not beyond human knowledge, were beyond human control. We might know the conditions necessary to the performance of a miracle, altho utterly unable to bring those conditions about. Yet a work performed by the bringing about of conditions which are out of human reach would certainly be a work attesting superhuman power.—ARGYLL *Reign of Law*, ch. 1, p. 15. (Burt.)

2218. MIRACLE, DIVINE AGENCY WITHOUT—*God Working in and through Natural Law.*—"These see the works of the Lord and his wonders in the deep. For he commandeth and raiseth the stormy wind which lifteth up the waves thereof" (Ps. cvii, 24-25).

He raises the tempest, not without the wind, but by the wind. In the one way it would have been a miracle, in the other way it is alike effectual, but without any change in the properties or laws of visible Nature—without what we commonly understand by a miracle.—CHALMERS *Astronomical Discourses*, suppl. disc. 2, p. 243. (R. Ct., 1848.)

2219. MIRAGE AMONG ICE-FLOES—*Cities and Towers of Cloudland.*—The truly wonderful scenery of Glacier Bay appeals most forcibly to the imagination during the lengthened twilights of summer. The latitude corresponds with that of the extreme north of Scotland. In summer the sun declines but a few degrees below the northern horizon, and the nights are sufficiently light to reveal the white-robed mountains in half-tones of the most delicate beauty. At such times the thousands of bergs and the broad ice-floes are transformed by the tricks of the mirage into shapes of the most remarkable description. Vast cities, with colonnades and ruined temples, towers and battlements, appear with marvelous realism where only a few moments before there was but a glassy plain of water studded with fragments of floating ice. Sheaf-like fountains and monumental shafts appear with such faithful imagery that one is more than half inclined

to yield to the delusion and believe that the apparitions are real. The weird beauty of the expanse of ice-freighted waters and the cold, stern, snow-covered mountains, as well as the lively anticipation of what is to come, make a sail on those northern waters, in brilliant weather, an event that thrills the fancy and leaves an indelible picture on the memory.—RUSSELL *Glaciers of North America*, ch. 6, p. 81. (G. & Co., 1897.)

2220. "MISCHIEF" IN CHILDREN— *Result of Constructive Instinct.*—Constructiveness is as genuine and irresistible an instinct in man as in the bee or the beaver. Whatever things are plastic to his hands, those things he must remodel into shapes of his own, and the result of the remodeling, however useless it may be, gives him more pleasure than the original thing. The mania of young children for breaking and pulling apart whatever is given them is more often the expression of a rudimentary constructive impulse than of a destructive one. "Blocks" are the playthings of which they are least apt to tire. Clothes, weapons, tools, habitations, and works of art are the result of the discoveries to which the plastic instinct leads, each individual starting where his forerunners left off, and tradition preserving all that once is gained.—JAMES *Psychology*, vol. ii, ch. 24, p. 426. (H. H. & Co., 1899.)

2221. MISER A LUNATIC — *Typical Hoard of Miser in Boston.*—In every lunatic asylum we find the collecting instinct developing itself in an equally absurd way. Certain patients will spend all their time picking pins from the floor and hoarding them. Others collect bits of thread, buttons, or rags, and prize them exceedingly. Now, "the miser" *par excellence* of the popular imagination and of melodrama, the monster of squalor and misanthropy, is simply one of these mentally deranged persons. . . . Even as I write, the morning paper gives an account of the emptying of a miser's den in Boston by the City Board of Health. What the owner hoarded is thus described:

"He gathered old newspapers, wrapping-paper, incapacitated umbrellas, canes, pieces of common wire, cast-off clothing, empty barrels, pieces of iron, old bones, battered tinware, fractured pots, and bushels of such miscellany as is to be found only at the city 'dump.' The empty barrels were filled, shelves were filled, every hole and corner was filled, and in order to make more storage-room, 'the hermit' covered his storeroom with a network of ropes, and hung the ropes as full as they could hold of his curious collections. There was nothing one could think of that wasn't in that room. As a wood-sawyer the old man had never thrown away a saw-blade or a wood-buck. The bucks were rheumatic and couldn't stand up, and the saw-blades were worn down to almost nothing in the middle. Some had been actually worn in two, but the ends were carefully saved and stored away. As a coal-heaver the old man had never cast off a worn-out basket, and there were dozens of the remains of the old things, patched up with canvas and rope-yarns, in the storeroom. There were at least two dozen old hats, fur, cloth, silk, and straw," etc.—JAMES *Psychology*, vol. ii, ch. 24, p. 424. (H. H. & Co., 1899.)

2222. MISINTERPRETATION, POPULAR, OF SCIENTIFIC PHENOMENON— I found an opinion prevalent among the sailors of the Spanish ships of the Pacific, that the age of the moon might be determined before the first quarter by looking at it through a piece of silk and counting the multiplied images. Here we have a phenomenon of diffraction observed through fine slits.—HUMBOLDT *Cosmos*, vol. iii, p. 129. (H., 1897.)

2223. MISSILES, METEORIC—*Air as Armor—A Soft but Sure Defense—The Ceaseless Rain of Meteors Shed Harmlessly Away.*—How, then, is it, it may be asked, that we never hear of even an accident from ordinary meteors, tho accidents from aerolites have not been altogether unknown? Here is this great vessel, the earth, sailing through space, and saluted every twenty-four hours by 400 millions of missiles, each flying towards her with many times the velocity of the swiftest cannon-ball. This goes on by day and by night, when living creatures are far from shelter as well as when they are protected in their various abodes; and yet the inhabitants of earth are perfectly safe from all danger. It is not merely that they have been so far fortunate as to escape hitherto, but that they really are as safe as tho the earth were protected by those three-feet armor-plates which will one day, we are told, defend our floating batteries.

The real protection of the earth is the air which surrounds her. Soft as the air is, the resistance it opposes to swift motion is very great. The swifter the motion the more effective is the resistance. In the case of the meteoric missiles falling on the earth the resistance is so great, owing to their enormous velocity, that they are consumed and presently vaporized in their rush through the upper parts of the air. Thus the air forms a perfect protection to our earth.—PROCTOR *Expanse of Heaven*, p. 164. (L. G. & Co., 1897.)

2224. ——— *Unseen Dangers—We Live Safely under an Annual Rain of One Hundred and Fifty Thousand Millions of Meteors.*—It is perhaps sufficiently startling to be told at the outset that nearly all shooting stars—nine hundred and ninety-nine out of every thousand, certainly—are missiles which rush towards the earth with a velocity far exceeding that of the swiftest cannon-ball. They are not missiles which miss their mark. They do not, as was once thought, merely graze our atmosphere. They come straight towards the earth, and many among them must make straight towards

living creatures on the earth. And tho they are for the most part small, they are by no means so small as to be unable to destroy life. Their swift motions make up for their smallness, and the actual momentum of some of the tiniest of these bodies is equivalent to the momentum of a cannon-ball. . . .

It has been estimated by Professor Simon Newcomb, of America, on grounds which are perfectly reliable, that including telescopic meteors (that is, meteors so small as only to be visible when they happen to pass across the field of view of a telescope) no less than 146,000 millions of meteoric bodies fall each year upon the earth. If one in a thousand struck a human being the inhabitants of the earth would be decimated in a single year.—PROCTOR *Expanse of Heaven*, p. 163. (L. G. & Co., 1897.)

2225. MISSILES OF DESTRUCTION —*Treasure Lavished for Defense—Expense of Modern Steel Guns.*—There are great steel rifles now in place on our coasts, with a bore of twelve inches, that will fire a shot twelve miles, and no steel armor used for ship protection could withstand such a shot. These guns are mounted on disappearing carriages. They are loaded and aimed behind the earthworks and then elevated and fired, after which they immediately disappear to a place of safety. The gunners are not exposed to the direct fire of the enemy, and the gun itself only for a short time. We are told that the United States has now under construction a still larger gun that will shoot still farther, and one shot well aimed will be sufficient to disable the strongest battle-ship that floats. This gun will weigh 140 tons when completed, and will have a bore of sixteen inches in diameter. Each shot will cost the government $1,000, but it will be much more economical to fire $1,000 shots than $500 shots if the former sinks a $2,000,000 ship each time it strikes the target, while the latter only makes an indentation in the armor, without piercing it. The present 12-inch-bore guns require 520 pounds of powder to fire them.—ELISHA GRAY *Nature's Miracles*, vol. ii, ch. 31, p. 242. (F. H. & H., 1900.)

2226. MISSILES, USE OF, BY MONKEY—He [a brown capuchin monkey] became very angry and threw at her [a stranger who had laughed at him] everything he could lay his hands on; first the nut, then the hammer, then a coffee-pot which he seized out of the grate, and, lastly, all his own shawls. He throws things with great force and precision by holding them in both hands, and extending his long arms well back over his head before projecting the missile, standing erect the while.

There is continual war between him and Sharp [a small terrier], but they both seem to have a certain mutual respect for each other. The dog makes snatches at nuts, etc., and runs away with them beyond the reach of his chain, and the monkey catches at the dog, but seems afraid to hold him or hurt him. He, however, pelts him with nuts or bits of carrot, and chatters at him.

[At a later date:] When he throws things at people now he first runs up the bars of the clothes-horse; he seems to have found out that people do not much care for having things thrown at their feet, and he is not strong enough to throw such heavy objects as a poker or a hammer at people's heads; he therefore mounts to a level with his enemy's head, and thus succeeds in sending his missile to a greater height and also to a greater distance.—ROMANES *Animal Intelligence (extracts from diary of author's sister)*, ch. 17, pp. 485, 490. (A., 1899.)

2227. MISTLETOE AS A PARASITE —*Idle Appropriation of Stores Gathered by Another Organism.*—I have before me a piece of an apple-tree's branch. It has been cut through dexterously enough, and the relations of a sprig of mistletoe which has attached itself to the bough are rendered clear and distinct. The mistletoe is not merely a lodger on the apple; it is a boarder likewise. Like certain dissatisfied tenants nowadays, it insists on holding to its landlord, while it declines to pay rent in any shape or form. Into the substance of the apple-tree the parasite has dipped its sucking roots, and a whole array of these roots is seen in my section, serving to drink up into the mistletoe-plant the sap which the apple-tree has made and elaborated for its own use. There is no intermingling here of parasite and prey. It is an attachment pure and simple for purposes of lodgment and food.—WILSON *Glimpses of Nature*, ch. 21, p. 69. (Hum., 1892.)

2228. MIXTURE VS. UNION, DIFFERENCE ILLUSTRATED—*Expansive Force of Gunpowder—Air Not Necessary for Explosion.*—Gunpowder before it is burned is simply a mixture; when it is burned the carbon unites with the oxygen of the niter, creating carbon dioxid as well as setting free a large amount of nitrogen gas. One cubic inch of gunpowder will produce 207 cubic inches of gas at ordinary atmospheric pressure and when the temperature is only 60° F. Of course when the gunpowder is burned in a confined space the gases are intensely heated and will therefore occupy a much larger space than at a lower temperature. By keeping the fact in mind that powder, in its gaseous state, occupies so much more room than it does in the solid state, the reader can readily understand where the gunpowder gets its energy when it is burned. Its gases must expand instantly and enormously. Gunpowder does not require air to explode it, because the niter that is in the mixture is very rich in oxygen, so that when it is heated to the point of ignition there is an instantaneous union between the carbon of the charcoal and the oxygen

of the niter, producing a gas.—ELISHA GRAY *Nature's Miracles,* vol. ii, ch. 27, p. 221. (F. H. & H., 1900.)

2229. MOBILITY OF ATTENTION IN CHILDHOOD—*Lack of Organized Activities—Preoccupation by Immediate Sensation.*—Sensitiveness to immediately exciting sensorial stimuli characterizes the attention of childhood and youth. In mature age we have generally selected those stimuli which are connected with one or more so-called permanent interests, and our attention has grown irresponsive to the rest. But childhood is characterized by great active energy, and has few organized interests by which to meet new impressions and decide whether they are worthy of notice or not, and the consequence is that extreme mobility of the attention with which we are all familiar in children, and which makes their first lessons such rough affairs. Any strong sensation whatever produces accommodation of the organs which perceive it, and absolute oblivion, for the time being, of the task in hand. This reflex and passive character of the attention, which, as a French writer says, makes the child seem to belong less to himself than to every object which happens to catch his notice, is the first thing which the teacher must overcome. It never is overcome in some people, whose work, to the end of life, gets done in the interstices of their mind-wandering.—JAMES *Psychology,* vol. i, ch. 11, p. 417. (H. H. & Co., 1899.)

2230. MODIFICATION OF ANIMAL STRUCTURES—*Adaptation to New Conditions—Changes of Form in Ocean Depths.*—The abysmal fauna is not, in fact, remarkable for possessing a large number of primitive or archaic forms. It is mainly composed of a number of species belonging to the families and genera of our shallow-water fauna that have, from time to time, migrated into greater depths and become modified in their structure in accordance with the extraordinary conditions of their new habitat. There is very good reason to believe that this migration has been going on from time immemorial, and consequently we find a few forms typical of the bygone times, left to struggle for existence with the more recent immigrants from shallow waters.—HICKSON *Fauna of the Deep Sea,* ch. 5, p. 87. (A., 1894.)

2231. MODIFICATION OF PARTS IN ORCHIDS—*Evidence of Gradual Change—Adaptation by Alteration of Function.*—It is interesting to look at one of the magnificent exotic species [of orchids] or, indeed, at one of our humblest forms, and observe how profoundly it has been modified, as compared with all ordinary flowers, with its great labellum, formed of one petal and two petaloid stamens—with its singular pollen-masses . . . —with its column formed of seven cohering organs, of which three alone perform their proper function, namely, one anther and two generally confluent stigmas—with the third stigma modified into the rostellum and incapable of being fertilized—and with three of the anthers no longer functionally active, but serving either to protect the pollen of the fertile anther, or to strengthen the column, or existing as mere rudiments, or entirely suppressed. What an amount of modification, cohesion, abortion, and change of function do we here see! Yet hidden in that column, with its surrounding petals and sepals, we know that there are fifteen groups of vessels, arranged three within three, in alternate order, which probably have been preserved to the present time from being developed at a very early period of growth, before the shape or existence of any part of the flower is of importance for the well-being of the plant.—DARWIN *Fertilization of Orchids,* ch. 8, p. 245. (A., 1898.)

2232. MODIFICATIONS WROUGHT BY MAN ON THE EARTH—*Limits of Human Power.*—The modifications in the system of which man is the instrument do not, perhaps, constitute so great a deviation from previous analogy as we usually imagine; we often, for example, form an exaggerated estimate of the extent of our power in extirpating some of the inferior animals, and causing others to multiply, a power which is circumscribed within certain limits, and which, in all likelihood, is by no means exclusively exerted by our species. The growth of human population cannot take place without diminishing the numbers or causing the entire destruction of many animals. The larger beasts of prey, in particular, give way before us; but other quadrupeds of smaller size, and innumerable birds, insects, and plants, which are inimical to our interests, increase in spite of us, some attacking our food, others our raiment and persons, and others interfering with our agricultural and horticultural labors. We behold the rich harvest which we have raised by the sweat of our brow devoured by myriads of insects, and are often as incapable of arresting their depredations as of staying the shock of an earthquake or the course of a stream of lava.—LYELL *Principles of Geology,* bk. i, ch. 9, p. 150.

2233. MOLECULES OF GASES—*Distance and Size Infinitely Small—Molecular Theory—Infinite Minuteness Overwhelms the Mind.*—The very remarkable properties of gases, their apparently unlimited elasticity and indefinite powers of expansion, were very difficult to explain on any theory of their molecules being subject to such attractive and repulsive forces as seem to exist in other states of matter. A consideration of these properties, together with the power of diffusion by which gases of very different densities form a perfect mixture when in contact, and the fact that by the application of heat almost all liquids and

many solids can be changed into gases, led to the conception that they owed their peculiar properties to their molecules being in a state of intensely rapid motion in all directions. On this theory the molecules are very far apart in proportion to their size, and are continually coming in contact with each other. Owing to their perfect elasticity they rebound without loss of motion or energy, and their continual impact against the sides of the vessel containing them is what gives to gases their great expansibility. From a study of these various properties it has been calculated that at ordinary temperatures there are some hundreds of trillions of molecules in a cubic inch of gas, and that these collide with each other eight thousand millions of times in a second. The average length of the path between two collisions of a molecule is less than the two-hundred-thousandth of an inch, yet this small length is supposed to be at least a hundred times as great as the diameter of each molecule.—WALLACE *The Wonderful Century*, ch. 7, p. 54. (D. M. & Co., 1899.)

2234. MOLECULES OF IRON MAGNETIC—*Magnetism an Inherent Property—Ampère's Theory.*—Iron and steel have a peculiar property called magnetism. It is an attraction in many ways unlike the attraction of cohesion or the attraction of gravitation. It is very certain that magnetism is an inherent property of the molecules of iron and steel, and, to a small degree, other forms of matter. That is to say, the molecules are little natural magnets of themselves. It is as unnecessary to inquire why they are magnets as it is to inquire why the molecules of all ordinary substances possess the attraction of cohesion. The one is as easy to explain as the other. People of all ages have insisted upon making a greater mystery of all electrical and magnetic phenomena than they do of other natural forces. Ampère's theory is that electric currents are flowing around the molecules which render them magnetic; but it is just as easy to suppose that magnetism is an inherent quality of the molecule. (The word "molecule" is here used as referring to the smallest particle of iron.)

These little molecular magnets, so small that 100,000 million million million of them can be put into a cubic inch of space, have their attractions satisfied by forming into little molecular rings, with their unlike poles together, so that when the iron is in a natural or unmagnetized condition it does not attract other iron.—ELISHA GRAY *Nature's Miracles*, vol. iii, ch. 4, p. 25. (F. H. & H., 1900.)

2235. MONKEY TRAINED TO GATHER NUTS—*Limited Intelligence—Unwilling Obedience.*—The orang-outan, indeed, which for its resemblance in form to man, and apparently for no other good reason, has been assumed by Lamarck to be the most perfect of the inferior animals has been tamed by the savages of Borneo and made to climb lofty trees, and to bring down the fruit. But he is said to yield to his masters an unwilling obedience, and to be held in subjection only by severe discipline. We know nothing of the faculties of this animal which can suggest the idea that it rivals the elephant in intelligence, much less anything which can countenance the dreams of those who have fancied that it might have been transmuted into the "dominant race." One of the baboons of Sumatra *(Simia carpolegus)* appears to be more docile, and is frequently trained by the inhabitants to ascend trees for the purpose of gathering coconuts, a service in which the animal is very expert. He selects, says Sir Stamford Raffles, the ripe nuts with great judgment, and pulls no more than he is ordered. The capuchin and cacajao monkeys are, according to Humboldt, taught to ascend trees in the same manner, and to throw down fruit, on the banks of the lower Orinoco.—LYELL *Principles of Geology*, bk. iii, ch. 35, p. 599. (A., 1854.)

2236. MONOTONY OF SOUTH-AMERICAN PLAINS—*Birds Subdued by Nature's Silence.*—The general aspect of the plain is monotonous, and in spite of the unobstructed view and the unfailing verdure and sunshine, somewhat melancholy, altho never somber; and doubtless the depressed and melancholy feeling the pampa inspires in those who are unfamiliar with it is due in a great measure to the paucity of life and to the profound silence. The wind, as may well be imagined on that extensive level area, is seldom at rest; there, as in the forest, it is a "bard of many breathings," and the strings it breathes upon give out an endless variety of sorrowful sounds, from the sharp, fitful sibilations of the dry, wiry grasses on the barren places to the long, mysterious moans that swell and die in the tall, polished rushes of the marsh. It is also curious to note that, with a few exceptions, the resident birds are comparatively very silent, even those belonging to groups which elsewhere are highly loquacious. . . . As a rule, their voices are strangely subdued; Nature's silence has infected them, and they have become silent by habit.—HUDSON *Naturalist in La Plata*, ch. 1, p. 8. (C. & H., 1895.)

2237. MONSTERS OF SENTIMENTALITY—*Woman Weeping in Theater—Coachman Freezing Outside—Resolute Doing to Keep Character Real (Matt. vii, 24-29).*—All goods are disguised by the vulgarity of their concomitants in this workaday world; but woe to him who can only recognize them when he thinks them in their pure and abstract form! The habit of excessive novel-reading and theatergoing will produce true monsters in this line. The weeping of a Russian lady over the fictitious personages in the play, while her coachman is freezing to death on his seat outside, is the

sort of thing that everywhere happens on a less glaring scale. Even the habit of excessive indulgence in music, for those who are neither performers themselves nor musically gifted enough to take it in a purely intellectual way, has probably a relaxing effect upon the character. One becomes filled with emotions which habitually pass without prompting to any deed, and so the inertly sentimental condition is kept up. The remedy would be never to suffer one's self to have an emotion at a concert without expressing it afterwards in some active way. Let the expression be the least thing in the world—speaking genially to one's aunt, or giving up one's seat in a horse-car, if nothing more heroic offers—but let it not fail to take place.—JAMES *Psychology*, vol. ii, ch. 4, p. 125. (H. H. & Co., 1899.)

2238. MONUMENTS CONFIRMING HISTORIAN'S ACCURACY—*Herodotus and Persian Impostor.*—The way in which modern discoveries have come in to confirm his [Herodotus's] statements justifies us in relying on ancient historians when, like him, they are careful to distinguish mere legend or hearsay from what they have themselves inquired into. Thus Herodotus tells the strange story of the impostor who passed himself off as Smerdis, and sat on the throne of Persia till he was detected by his cropped ears, and Darius slew him. When, a few years ago, the cuneiform characters of the inscription sculptured in a high wall of rock near Behistan in Persia were deciphered, it proved to be the very record set up by Darius the king in the three languages of the land, and it matches the account given by Herodotus closely enough to show what a real grasp he had of the course of events in Persia a century before his time.—TYLOR *Anthropology*, ch. 15, p. 386. (A., 1899.)

2239. MOON, PHASES OF, THE BASIS OF THE CALENDAR—"*He Appointeth the Moon for Seasons*" (*Ps. civ, 19*).—The proper motion of the moon from west to east, and the succession of phases, may be considered as the most ancient facts of observation of the sky, and as the first basis of measurement of time and of the calendar.—FLAMMARION *Popular Astronomy*, bk. ii, ch. 1, p. 95. (A.)

2240. MOON, SUPPOSED PERNICIOUS EFFECT OF—*Blindness Ascribed to Moonbeams—The Chill of Celestial Space.*—My face [when attempting to sleep at night on the Weisshorn] was turned towards the moon until it became so chilled that I was forced to protect it by a light handkerchief. The power of blinding the eyes is ascribed to the moonbeams, but the real mischief is that produced by radiation from the eyes into clear space, and the inflammation consequent upon the chill.—TYNDALL *Hours of Exercise in the Alps*, ch. 9, p. 96. (A., 1898.)

2241. MORALITY AND SCIENCE—*Evolution as Prophecy—Progress in Future as in Past.*—The doctrine of evolution presents its greatest attractiveness when viewed, not merely in its scientific aspect, as the highest form of the intellectual interpretation of Nature, but in its moral bearings, as one which leads man ever onwards and upwards, and encourages his brightest anticipations of the ultimate triumph of truth over error, of knowledge over ignorance, of right over wrong, of good over evil, thus claiming the earnest advocacy of every one who accepts it as scientifically true.—CARPENTER *Nature and Man*, lect. 14, p. 408. (A., 1889.)

2242. MORALITY DEMANDS ACTION IN LINE OF GREATEST RESISTANCE—*Ease of Following Propensities—A Struggle for Ideals.*—When outer forces impinge upon a body, we say that the resultant motion is in the line of least resistance, or of greatest traction. But it is a curious fact that our spontaneous language never speaks of volition with effort in this way. . . . He who under the surgeon's knife represses cries of pain, or he who exposes himself to social obloquy for duty's sake, feels as if he were following the line of greatest temporary resistance. He speaks of conquering and overcoming his impulses and temptations.

But the sluggard, the drunkard, the coward, never talk of their conduct in that way or say they resist their energy, overcome their sobriety, conquer their courage, and so forth. If in general we class all springs of action as propensities on the one hand and ideals on the other, the sensualist never says of his behavior that it results from a victory over his ideals, but the moralist always speaks of his as a victory over his propensities. The sensualist uses terms of inactivity, says he forgets his ideals, is deaf to duty, and so forth: which terms seem to imply that the ideal motives *per se* can be annulled without energy or effort, and that the strongest mere traction lies in the line of the propensities. . . . And if a brief definition of ideal or moral action were required, none could be given which would better fit the appearances than this: It is action in the line of the greatest resistance. —JAMES *Psychology*, vol. ii, ch. 26, p. 548. (H. H. & Co., 1899.)

2243. MORALITY DISTINCTIVE—*Contrasted with Habit and Expediency.*—The difference between the *habitual*, the *prudential*, and the *moral* aspects of the very same action may be made apparent by a very simple illustration: We will suppose that a man has been accustomed to take a ride every day at a particular hour; his whole nature so accommodates itself to the habit that he feels both mentally and physically uncomfortable at any interruption to the usual rhythm. But suppose that, just as the appointed hour comes round, the sky

becomes overcast, threatening the rider with a drenching if he perseveres in his intention; his decision will then be founded on a prudential consideration of the relative probabilities of his escaping or of his being exposed to the shower, and of how far the enjoyment he may derive from his ride is likely to be replaced by the discomfort of a thorough wetting. But suppose, further, that instead of taking a mere pleasure ride, a medical man is about to set forth on a professional visit to a patient whose condition requires his aid; a new motive is thus introduced, which alters the condition of the whole question, making it no longer one of prudence only, but one of morality.—CARPENTER *Mental Physiology*, ch. 9, p. 416. (A., 1900.)

2244. MORALITY, ELEMENTAL, OF LOWER ANIMALS—*"Man the God of the Dog."*—Of these elementary moral feelings, those of the lower animals which associate most closely with man are obviously capable. The sense of duty towards a being of a higher nature, which shows itself in the actions of the young child towards its parent or nurse, long before any ideational comprehension of it can have been attained, is exactly paralleled by that of the dog or the horse towards its master. "Man," as Burns truly says, "is the god of the dog."—CARPENTER *Mental Physiology*, bk. i, ch. 5, § 190, p. 212. (A., 1900.)

2245. MORALITY INDEPENDENT OF REWARD OR PUNISHMENT—It is true, indeed, that these rightful authorities, which are enthroned in Nature, are fortified by power to enforce their commands, and to punish violations of the duty of obedience. It is true, therefore, that from the first moments of our existence the sense of obligation is reenforced by the fear of punishment. And yet we know, both as a matter of internal consciousness, and as a matter of familiar observation in others, that this sense of obligation is not only separable from the fear of punishment, but is even sharply contradistinguished from it. Not only is the sense of obligation powerful in cases where the fear of punishment is impossible, but in direct proportion as the fear of punishment mixes or prevails, the moral character of an act otherwise good is diminished or destroyed. The fear of punishment and the hope of reward are, indeed, auxiliary forces which cannot be dispensed with in society. But we feel that complete goodness and perfect virtue would dispense with them altogether.—ARGYLL *Unity of Nature*, ch. 9, p. 211. (Burt.)

2246. MORALITY IN INTENTION—There can be no moral character in any action, so far as the individual actor is concerned, apart from the meaning and intention of the actor. The very same deed may be good or, on the contrary, devilishly bad, according to the inspiring motive of him who does it. The giving of a cup of cold water to assuage suffering, and the giving it to prolong life in order that greater suffering may be endured, are the same outward deeds, but are exactly opposite in moral character.—ARGYLL *Unity of Nature*, ch. 9, p. 197. (Burt.)

2247. MORALITY NOT A MATTER OF SEX—*Pugnacity of Men and Women.*—Tho the female sex is often said to have less pugnacity than the male, the difference seems connected more with the extent of the motor consequences of the impulse than with its frequency. Women take offense and get angry, if anything, more easily than men, but their anger is inhibited by fear and other principles of their nature from expressing itself in blows.—JAMES *Psychology*, vol. ii, ch. 24, p. 415. (H. H. & Co., 1899.)

2248. MORALS, FOUNDATION OF—*Imaginary Laws of Nature—Rousseau—The French Revolution.*—M. Comte was right in affirming that the prevailing schools of moral and political speculation, when not theological, have been metaphysical. They affirmed that moral rules, and even political institutions, were not means to an end, the general good, but corollaries evolved from the conception of natural rights. This was especially the case in all the countries in which the ideas of publicists were the offspring of the Roman law. The legislators of opinion on these subjects, when not theologians, were lawyers: and the Continental lawyers followed the Roman jurists, who followed the Greek metaphysicians, in acknowledging as the ultimate source of right and wrong in morals, and consequently in institutions, the imaginary law of the imaginary being Nature. The first systematizers of morals in Christian Europe, on any other than a purely theological basis, the writers on international law, reasoned wholly from these premises, and transmitted them to a long line of successors. This mode of thought reached its culmination in Rousseau, in whose hands it became as powerful an instrument for destroying the past as it was impotent for directing the future. The complete victory which this philosophy gained in speculation over the old doctrines was temporarily followed by an equally complete practical triumph, the French Revolution; when, having had, for the first time, a full opportunity of developing its tendencies, and showing what it could not do, it failed so conspicuously as to determine a partial reaction to the doctrines of feudalism and Catholicism.—MILL *Positive Philosophy of Auguste Comte*, p. 64. (H. H. & Co., 1887.)

2249. MOTH ASSUMES INSTANT INVISIBILITY—*Protective Mimicry.*—It was in the beautiful Riviera, where insect life continues much more active at that season than it can be anywhere in the north of Europe. But even there, altho bees are busy during the greater part of winter, and some of our own *Sylviadæ* find an abundant living

throughout the season, the order of the *Lepidoptera* are generally dormant. I was surprised, therefore, late in the month of November, to see a large insect of this order come from above the olive-trees overhead with the wild, dashing flight of the larger moths. Attracted apparently by a sheltered and sunny recess in which scarlet geraniums and bignonias were in full flower, the moth darted downwards, and, after a little hovering, settled suddenly on the bare ground underneath a geranium-plant. I then saw that it was a very handsome species, with an elaborate pattern of light and dark chocolate browns. But the margins of the upper or anterior wings, which were deeply waved in outline, had a lustrous yellow color, like a brilliant gleam of light. In this position the moth was a conspicuous object. After resting for a few seconds, apparently enjoying the sun, it seemed to notice some movement which gave it alarm. It then turned slightly round, gave a violent jerk to its wings, and instantly became invisible. If it had subsided into a hole in the ground, it could not have more completely disappeared. As, however, my eyes were fixed upon the spot, I soon observed that all the interstices among the little clods around were full of withered and crumpled leaves of a deep blackish brown. I then further noticed that the spot where the moth had sat was apparently occupied by one of these, and it then flashed upon me in a moment that I had before me one of the great wonders and mysteries of Nature.—ARGYLL *Unity of Nature*, ch. 3, p. 52. (Burt.)

2250. MOTH TRUSTING ITS INVISIBILITY—*Protective Mimicry a Source of Confidence.*—And now I tried an experiment to test another feature in the wonderful instincts which are involved in all these operations. That feature is the implicit confidence in its success which is innate in all creatures furnished with any apparatus of concealment. I advanced in the full sunlight close up to the moth—so close that I could see the prominent "beaded eyes," with the watchful look, and the roughened outlines of the thorax, which served to complete the illusion. So perfect was the deception that I really could not feel absolutely confident that the black spot I was examining was what I believed it to be. Only one little circumstance reassured me. There was a small hole in the outer covering through which a mere point of the inner brilliant margin could be seen shining like a star. Certain now as to the identity of the moth, I advanced still nearer, and finally I found that it was not till the point of a stick was used to touch and shake the earth on which it lay that the creature could believe that it was detected and in danger. Then in an instant, by movements so rapid as to escape the power of vision, the dried and crumpled leaf became a living moth, with energies of flight defying all attempts at capture. [See MIMICRY, PROTECTIVE.]—ARGYLL *Unity of Nature*, ch. 3, p. 52. (Burt.)

2251. MOTHERHOOD, THE EVOLUTION OF—*Elementary Animals Orphans.*—Crossing into the animal kingdom we observe the same motherless beginning [as among the plants]. All elementary animals are orphans; they know neither home nor care; the earth is their only mother or the inhospitable sea; they waken to isolation, to apathy, to the attentions only of those who seek their doom. But as we draw nearer the apex of the animal kingdom, the spectacle of a protective maternity looms into view. At what precise point it begins it is difficult to say. But that it does not begin at once—that there is a long and gradual evolution of maternity—is clear.—DRUMMOND *Ascent of Man*, ch. 8, p. 269. (J. P., 1900.)

2252. MOTHERHOOD THE MOST STUPENDOUS TASK OF EVOLUTION—The evolution of a mother, in spite of its half-humorous, half-sacrilegious sound, is a serious study in biology. Even on its physical side this was the most stupendous task evolution ever undertook. It began when the first bud burst from the first plant-cell, and was only completed when the last and most elaborately wrought pinnacle of the temple of Nature crowned the animal creation.—DRUMMOND *Ascent of Man*, ch. 8, p. 267. (J. P., 1900.)

2253. MOTHERHOOD, TRAINING FOR—*Care of Dolls an Inadequate Preparation.*—You present a little girl in her cradle with a doll, and let her play with it until she grows older. Then you add a doll's house and furnish it with every appurtenance you can find. Why? Because you want to prepare the child in her play for the activities of her future calling as a woman, because you desire to awaken the sensibilities of womanhood and direct them to the usages of the nursery. Very good! But after that there comes a great vacuum. The doll is relegated to a corner. The entire world appears to the maiden in disguise, veiled. Not until she faces her own child is the young mother placed before the real object. Do you not perceive that we have here a great error, the greatest that society makes? Do you not see that it is a sin to entrust a living child to a mother whose training for the earnest duty she now faces was received in a doll's house? And that, too, to a mother in such complicated circumstances as those of the society of our day, with all of its distractions, its quixotic fashions, its dislocated and superstitious traditions?—VIRCHOW *(a Lecture)*. (Translated for *Scientific Side-Lights.)*

2254. MOTION, APPARENT, OF THE SUN AMONG THE STARS—If we observe, night after night, the exact hour and minute at which a star passes any point by its

diurnal revolution, we shall find that passage to occur some four minutes earlier every evening than it did the evening before. The starry sphere therefore revolves, not in 24 hours, but in 23 hours 56 minutes. In consequence, if we note its position at the same hour night after night, we shall find it to be farther and farther to the west. Let us take, for example, the brightest star in the constellation Leo, . . . and commonly known as Regulus. If we watch it on the 22d of March, we shall find that it passes the meridian at ten o'clock in the evening. On April 22d it passes at eight o'clock, and at ten it is two hours west of the meridian. On the same day of May it passes at six, before sunset, so that it cannot be seen on the meridian at all. When it first becomes visible in the evening twilight, it will be an hour or more west of the meridian. In June it will be three hours west, and by the end of July it will set during twilight, and will soon be entirely lost in the rays of the sun. This shows that during the months in question the sun has been approaching the star from the west, and in August has got so near it that it is no longer visible. Carrying forward our computation, we find that on August 21st the star crosses the meridian at noon, and therefore at nearly the same time with the sun. In September it crosses at ten in the morning, while the sun is on the eastern side. The sun has therefore passed from the west to the east of the star, and the latter can be seen rising in the morning twilight before the sun. It constantly rises earlier and earlier, and therefore farther from the sun, until February, when it rises at sunset and sets at sunrise, and is therefore directly opposite the sun. In March the star would cross the meridian at ten o'clock once more, showing that in the course of a year the sun and star had resumed their first position. But, while the sun has risen and set 365 times, the star has risen and set 366 times, the sun having lost an entire revolution by the slow backward motion we have described. . . . The path which the sun describes among the stars in his annual revolution is called the ecliptic. . . . A belt of the heavens, extending a few degrees on each side of the ecliptic, is called the zodiac.—NEWCOMB *Popular Astronomy*, ch. 1, p. 14. (H., 1899.)

2255. MOTION AS ESSENTIAL IN THE SIDEREAL WORLD AS IN THE ORGANIC—If, . . . , we imagine the acuteness of our senses preternaturally heightened to the extreme limits of telescopic vision, bringing together events separated by wide intervals of time, the apparent repose which reigns in space will suddenly vanish. Countless stars will be seen moving in groups in various directions; nebulæ wandering, condensing, and dissolving like cosmical clouds; the Milky Way breaking up in parts and its veil rent asunder. In every point of the celestial vault we should recognize the dominion of progressive movement just as on the surface of the earth, where vegetation is constantly putting forth leaves and buds and unfolding into blossoms. The celebrated Spanish botanist, Cavanilles, first conceived the possibility of seeing grass grow by placing the horizontal micrometer wire of a telescope with a high magnifying power at one time on the point of a bamboo shoot, at another on the rapidly unfolding flowering stem of an American aloe, precisely as the astronomer places the cross of wires on a culminating star. Throughout the whole life of physical nature in the organic, as in the sidereal world, existence, preservation, production, and development, are alike associated with motion as their essential condition.—HUMBOLDT *Cosmos*, vol. i, p. 139. (Translated for *Scientific Side-Lights.*)

2256. MOTION, ATOMIC, NOT CONVERTIBLE INTO CONSCIOUSNESS—In his celebrated "Address to the Congress of German Naturforscher," delivered at Leipsic [in 1872] Du Bois-Reymond speaks thus: "What conceivable connection subsists between definite movements of definite atoms in my brain, on the one hand, and on the other hand such primordial, indefinable, undeniable facts as these: I feel pain or pleasure; I experience a sweet taste, or smell a rose, or hear an organ, or see something red. It is absolutely and forever inconceivable that a number of carbon, hydrogen, nitrogen, and oxygen atoms should be otherwise than indifferent as to their own position and motion, past, present, or future. It is utterly inconceivable how consciousness should result from their joint action."—TYNDALL *Fragments of Science*, vol. ii, ch. 11, p. 226. (A., 1900.)

2257. MOTION, CEASELESS, OF LUMINIFEROUS ETHER—We on the earth's surface live night and day in the midst of ethereal commotion. The medium is never still. The cloud canopy above us may be thick enough to shut out the light of the stars, but this canopy is itself a warm body, which radiates its thermal motion through the ether. The earth also is warm, and sends its heat-pulses incessantly forth. It is the waste of its molecular motion in space that chills the earth upon a clear night; it is the return of thermal motion from the clouds which prevents the earth's temperature on a cloudy night from falling so low. To the conception of space being filled we must, therefore, add the conception of its being in a state of incessant tremor.—TYNDALL *Fragments of Science*, vol. i, ch. 1, p. 8. (A., 1897.)

2258. MOTION CONVERTED INTO HEAT—*Iron Made Hot by Hammering.*—Robert Boyle appears to have seen as clearly as we do to-day that when heat is generated by mechanical means, new heat is called into existence. In describing one of his experi-

ments he uses the following remarkable language: "It will be convenient to begin with an instance or two of the production of heat, wherein there appears not to intervene anything on the part of the agent or patient but local motion and the natural effects of it. When, for example, a smith does hastily hammer a nail or such like piece of iron the hammered metal will grow exceedingly hot; and yet there appears not anything to make it so, save the forcible motion of the hammer, which impresses a vehement and variously determined agitation of the small parts of the iron, which, being a cold body before, by that superinduced commotion of its small parts, becomes in divers senses hot; first, in a more lax acceptation of the word in reference to some other bodies, in respect of whom it was cold before, and then sensibly hot: because this newly gained agitation surpasses that of the parts of our fingers.—TYNDALL *Heat a Mode of Motion*, lect. 1, p. 34. (A., 1900.)

2259. MOTION CREATING HEAT—*Fire Kindled by Friction.*—Taking an elastic stick about eighteen inches long, he [the Guacho on the pampas] presses one end on his breast and the other (pointed) end into a hole in a piece of wood, and then rapidly turns the curved part, like a carpenter's center-bit.—DARWIN *Naturalist's Voyage around the World*, ch. 18, p. 409. (A., 1898.)

2260. MOTION ESSENTIAL TO LIFE—*Air and Water Made Habitable by Movement.*—It is not enough that we have the air in which we live and move, with all of its properties, as we have described: something more is needed which is absolutely essential both to animal and vegetable life, and this essential is motion. If the air remained perfectly still, with no lateral movement or upward and downward currents of any kind, we should have a perfectly constant condition of things, subjected only to such gradual changes as the advancing and receding seasons would produce owing to the change in the angle of the sun's rays. No cloud would ever form, no rain would ever fall, and no wind would ever blow. It is of the highest importance not only that the wind shall blow, but that comparatively sudden changes of temperature take place in the atmosphere, in order that vegetation as well as animal life may exist upon the surface of the globe. The only place where animal life could exist would be in the great bodies of water, and it is even doubtful if water could remain habitable unless there were means provided for constant circulation—motion.—ELISHA GRAY *Nature's Miracles*, vol. i, ch. 6, p. 45. (F. H. & H., 1900.)

2261. MOTION, HEAT LONG KNOWN AS—*Locke Foreshadows Molecular Theory.*—In his "Essay on the Human Understanding" Locke frequently refers to heat as being a kind of motion. But the very remarkable utterance which of late years has been most widely circulated is the following: "Heat," says Locke, "is a very brisk agitation of the insensible parts of the object, which produces in us that sensation from whence we denominate the object hot; so what in our sensation is heat, in the object is nothing but motion. This appears by the way heat is produced; for we see that the rubbing of a brass nail upon a board will make it very hot, and the axletrees of carts and coaches are often hot, and sometimes to a degree that it sets them on fire, by the rubbing of the naves of the wheels upon them. On the other side, the utmost degree of cold is the cessation of that motion of the insensible particles, which to our touch is heat."—LOCKE *Works*, vol. iv, p. 597, ed. of 1768, quoted by TYNDALL in *Heat a Mode of Motion*, lect. 2, p. 37. (A., 1900.)

2262. MOTION MAGNIFIED EQUALS TIME EXTENDED—*The Telescope Gives the Astronomer a Record of Ten Thousand Years.*—The magnifying power of the telescope in reality acts to magnify any effects of star motion. So that if a magnifying power of 100 is used, the astronomer could detect in one year any motion which, to the naked eye, would only be discernible in one hundred years.

Very few motions are discernible to ordinary vision (aided, of course, by an instrumental index devised to determine a star's place) in so short a time as one hundred years. But notice that in twenty or thirty years a telescopist, using the very moderate power named, would be able to detect a motion which ordinary vision would be able to recognize [only] after the lapse of two thousand or three thousand years. And our astronomers are not limited to twenty or thirty years. They can compare their observations with those made by such observers as Bradley and his contemporaries nearly a century and a half ago. This amounts, with moderate telescopic power, to the observation of effects equivalent to those which would be presented to the naked eye in the course of more than ten thousand years.—PROCTOR *Expanse of Heaven*, p. 281. (L. G. & Co., 1897.)

2263. MOTION NOT TO BE TRANSMUTED INTO SENSATION—*Thought Cannot Be Expressed in Terms of Chemistry.*—We can prove that bile arises in the liver by chemical processes which we are able, in part at least, to follow out in detail. We can show, too, that movement is produced in muscles by definite processes, which are again the immediate result of chemical transformation. But cerebral processes give us no shadow of indication as to how our mental life comes into being. For the two series of phenomena are not comparable. We can conceive how one motion may be transformed into another, perhaps also how

one sensation or feeling is transformed into a second. But no system of cosmic mechanics can make plain to us how a motion can pass over into a sensation or feeling.—WUNDT *Psychology,* lect. 1, p. 6. (Son. & Co., 1896.)

2264. MOTION OF STARS AND WORLDS HARMONIOUS—*A Shower of Stars—Pettiness of Merely Personal and Selfish Life.*—Thus perpetual motion bears the world along! The sun moves through space; the earth moves round him, letting herself be carried along in his flight; the moon moves, circulating round us, while we gravitate round the radiant hearth which precipitates itself into the eternal void. Like a shower of stars the worlds whirl, borne along by the winds of heaven, and are carried down through immensity; suns, earths, satellites, comets, shooting stars, humanities, cradles, graves, atoms of the infinite, seconds of eternity, perpetually transform beings and things; all move on, all wing their flight under the breath divine—while trade goes on, or the investor counts his gold and piles it up, believing that he holds the entire universe in his casket. O folly of terrestrial manikins! folly of busy merchants, folly of the miser, folly of the suitor, folly of the pilgrim to Mecca or to Lourdes, folly of the blind! When shall the inhabitant of the earth open his eyes to see where he is, to live the life of the mind, and to base his happiness on intellectual contemplations? When shall he throw off the old man, the animal cover, to free himself from the fetters of the flesh and soar in the heights of knowledge?—FLAMMARION *Popular Astronomy,* bk. ii, ch. 3, p. 109. (A.)

2265. MOTION OF STARS DETERMINED—*Spectroscopic Evidence of Approach or Recession.*—If the star is approaching or receding, the motion is reflected in the spectrum in a singular way. Let us suppose that it approaches. The lengths of the waves, which give rise to the diversity of colors, diminish, and the refrangibility of each color increases. If, then, we observe with a spectroscope two luminous sources, the one fixed (the electric tube), the other moving (the star), both giving, for example, the line ("D") so characteristic of sodium, we see in the two superposed spectra the rays of this metal, which will not coincide. The line D shown by the spectrum of the star will deviate from the line D shown by the tube, and the displacement will be towards the violet end if the star is approaching the earth, and towards the red end if it is receding. The difference will serve not only to ascertain whether the star is approaching or receding, but even to determine the velocity.—FLAMMARION *Popular Astronomy,* bk. vi, ch. 9, p. 648. (A.)

2266 MOTION PRODUCED BY HEAT—*Reconverted into Heat—Steam the Medium of Change.*—Those who have walked through the workshops of Woolwich, or through any of our great factories where machinery is extensively employed, will have been sufficiently impressed with the aid which the mighty power of heat renders to man. Let it be remembered that every wheel which revolves, every chisel, and plane, and punch, which passes through solid iron as if it were so much cheese, derives its moving energy from the clashing atoms in the furnace. The motion of these atoms is communicated to the boiler, thence to the water, whose molecules are shaken asunder, flying from each other with a repellent energy commensurate with the heat communicated. The steam is simply the apparatus, through the intermediation of which the atomic motion is converted into mechanical motion. And the motion thus generated always, in the long run, reproduces its parent. Look at the planing-tools and boring-instruments—streams of water gush over them to keep them cool. Take up the curled iron shavings which the planing-tool has pared off; you cannot hold them in your hand, they are so hot. Here the moving force is restored to its first form; the energy of the machine has been consumed in reproducing the power from which that energy was derived.—TYNDALL *Heat a Mode of Motion,* lect. 6, p. 165. (A., 1900.)

2267. MOTION TRANSFORMED INTO HEAT—*Heat Is Molecular Motion—Constancy of Force.*—In firing a ball against a target the projectile, after collision, is often found hot. Mr. Fairbairn informs me that in the experiments at Shoeburyness it is a common thing to see a flash, even in broad daylight, when the ball strikes the target. And if our lead weight be examined after it has fallen from a height it is also found heated. . . . When a violin bow is drawn across a string, the sound produced is due to motion imparted to the air, and to produce that motion muscular force has been expended. We may here correctly say that the mechanical force of the arm is converted into music. In a similar way we say that the arrested motion of our descending weight, or of the cannon-ball, is converted into heat. The mode of motion changes, but motion still continues; the motion of the mass is converted into a motion of the atoms of the mass; and these small motions, communicated to the nerves, produce the sensation we call heat.—TYNDALL *Fragments of Science,* vol. i, ch. 16, p. 371. (A., 1897.)

2268. MOTION, VIBRATION, AND HARMONY PERVADE ALL NATURE—*Correspondence of Music and Color.*—A universal motion bears along the stars, atoms of the infinite. The moon gravitates round the earth, the earth gravitates round the sun, the sun carries along all its planets and their satellites towards the constellation Hercules; and these motions are executed according to determined laws, like the hand of a watch which turns round its center, and like the circular undulations which are de-

veloped on the surface of still water when a point has been struck. This is a universal harmony which the physical ear cannot hear, as Pythagoras supposed, but which the intellectual ear can understand. And is it not music itself which vaguely lulls us on its seraphic wings, and so easily transports our minds into those ethereal regions of the ideal where we forget the fetters of matter? Do not the sonorous modulations of the organ, the sweet quiverings of the bow on the violin, the nervous languors of the cithara, or the still more captivating charm of the human voice, unite the raptures of life with the warm colors of harmony? What is it except an undulatory motion of the air contrived to reach the mind in the depths of the brain and to impress it with emotions of a special order? When the martial tones of the spirited "Marseillaise" are borne in the heat of the conflict to the excited battalions, or when, under the Gothic vault, the sad "Stabat" pours out its mournful notes, it is the vibration which affects us by speaking a mysterious language. Now, all in Nature is motion, vibration, and harmony. The flowers of the garden sing, and the effect which they produce depends on the number and agreement of their vibrations relatively to those which emanate from surrounding Nature. In violet light the atoms of the ether oscillate with the unheard-of rapidity of 740 billions of vibrations per second; red light, slower, is produced by undulations vibrating still at the rate of 380 billions per second. The violet color is, in the case of light, what the highest notes are in the case of sound, and the red color represents the lowest tones. As we see an object floating in the water obeying with docility the waves which come from different sides, so the atom of the ether undulates under the influence of light and heat, the atom of air undulates under the influence of sound, and the planet and satellite circulate under the influence of gravitation.—FLAMMARION *Popular Astronomy*, bk. iii, ch. 1, p. 221. (A.)

2269. MOTION WITHIN THE WALLS OF PLANTS—*Varied and Intense Activity.*—Without entering on the difficult question of spontaneous motion, or, in other words, on the difference between vegetable and animal life, we would remark that if Nature had endowed us with microscopic powers of vision, and the integuments of plants had been rendered perfectly transparent to our eyes, the vegetable world would present a very different aspect from the apparent immobility and repose in which it is now manifested to our senses. The interior portion of the cellular structure of their organs is incessantly animated by the most varied currents, . . . rotating, ascending and descending, ramifying, and ever changing their direction. . . . If to these manifold currents and gyratory movements we add the phenomena of endosmosis, nutrition, and growth, we shall have some idea of those forces which are ever active amid the apparent repose of vegetable life.—HUMBOLDT *Cosmos*, vol. i, p. 341. (H., 1897.)

2270. MOTIVE AND VOLITION NOT MECHANICALLY CONNECTED—*Character Determines Decision.*—The uncertainty of the connection of motive and volition is due, and due only, to the existence of the personal factor. In consequence of this, all motives are seen to be insufficient for the complete explanation of a voluntary action; they can never be constraining causes, but remain as partial determinants. And the motives of volition are insufficient for its explanation, simply because the nature of the personal factor itself and the manner of its cooperation with external factors are wholly unknown. At the same time the fact that an ineffectual motive leaves no trace upon the completed volition points towards the inference that external motive and internal factor do not cooperate as does a plurality of causes in Nature, but that personality is the only immediate cause of action, *i. e.*, that the only direct effect of a motive is exerted upon the personality. Properly speaking, therefore, we may not talk of a "personal factor," since that expression implies the simultaneous cooperation of other factors. Rather, since all the immediate causes of voluntary action proceed from personality, we must look for the origin of volition in the inmost nature of personality—in character.—WUNDT *Human and Animal Psychology*, lect. 29, p. 433. (Son. & Co., 1896.)

2271. MOUND-BUILDERS' STRUCTURES—*Artistic Earthworks—The "Animal Mounds."*—Not the least remarkable of the American antiquities are the so-called "animal mounds," which are principally, tho not exclusively, found in Wisconsin. In this district "thousands of examples occur of gigantic basso-relievos of men, beasts, birds, and reptiles, all wrought with persevering labor on the surface of the soil," while enclosures and works of defense are almost entirely wanting. — AVEBURY *Prehistoric Times*, ch. 8, p. 253. (A., 1900.)

2272. ——— ——— *Silent Evidence of Dense Agricultural Population — A Race without a Record.*—No proof of a knowledge of letters, no trace of a burnt brick, have yet been discovered; and so far as we may judge from their arms, ornaments, and pottery, the mound-builders closely resembled the more advanced of the recent Indian tribes, and the earthworks agree in form with, if they differ in magnitude from, those still, or until lately, in use. Yet this very magnitude is sufficient to show that, at some early period, the great river valleys of the United States must have been more densely populated than they were when first discovered by Europeans. . . . The Newark constructions; the mound near Florence in Alabama, which is forty-five feet in height by four hundred and forty feet in circumfer-

ence at the base, with a level area at the summit of one hundred and fifty feet in circumference; . . . these works, and many others which might have been quoted, indicate a population both large and stationary; for which hunting cannot have supplied enough food, as it has been estimated that in a forest country each hunter requires an area of not less than 50,000 acres for his support; and which must, therefore, have derived its support, in a great measure, from agriculture.—AVEBURY *Prehistoric Times*, ch. 8, p. 259. (A., 1900.)

2273. MOUNTAIN ENGULFED IN EARTH—*Earthquake in Java—Truncation of a Lofty Cone.*—In the year 1772, Papandayang, formerly one of the loftiest volcanoes in the island of Java, was in eruption. Before all the inhabitants on the declivities of the mountain could save themselves by flight, the ground began to give way, and a great part of the volcano fell in and disappeared. It is estimated that an extent of ground of the mountain itself and its immediate environs, fifteen miles long and full six broad, was by this commotion swallowed up in the bowels of the earth. Forty villages were destroyed, some being engulfed, and some covered by the substances thrown out on this occasion, and 2,957 of the inhabitants perished. . . . This catastrophe appears to have resembled, tho on a grander scale, that of the ancient Vesuvius in the year 79.—LYELL *Principles of Geology*, bk. ii, ch. 29, p. 493. (A., 1854.)

2274. MOUNTAIN SLOWLY SINKING—*Wider Prospect from Neighboring Heights—Earth's Crust Changing Now.*—Two examples of rapid earth-movement are taken from Professor Rossi's "Meteorologia Endogena." Professor D. Seghetti, writing to Professor Rossi, says that a few lusters ago (one luster = twenty years) Mount S. Giovanni hid the towns Jenne and Subiaco from each other. From Subiaco the church at Jenne is now visible, which a few years ago was invisible. The people at Jenne also can see more than formerly. The supposition is that the side of Mount S. Giovanni is lowered. This fact corresponds to a fact stated by Professor Carina, who says that forty or fifty years ago from Granaiola you could not see either the church of S. Maria Assunta di Citrone or the church of S. Pietro di Corsena. Now you can see both.—MILNE *Earthquakes*, ch. 21, p. 351. [A. 1899.]

2275. MOUNTAIN-BUILDING A LONG AND COMPLICATED PROCESS—*Extends through Ages (Ps. xc, 2).*—Mountain chains may be regarded as cicatrized wounds in the earth's solid crust. A line of weakness first betrays itself at a certain part of the earth's surface by fissures, from which volcanic outbursts take place; and thus the position of the future mountain chain is determined. Next, subsidence during many millions of years permits of the accumulation of the raw materials out of which the mountain range is to be formed; subsequent earth-movements cause these raw materials to be elaborated into the hardest and most crystalline rock-masses, and place them in elevated and favorable positions; and lastly, denudation sculptures from these hardened rock-masses all the varied mountain forms. Thus the work of mountain-making is not, as was formerly supposed by geologists, the result of a simple upheaving force, but is the outcome of a long and complicated series of operations.—JUDD *Volcanoes*, ch. 10, p. 300. (A., 1899.)

2276. MOUNTAINS AS A DEFENSE AGAINST EARTHQUAKES—*Shocks Limited by Mountain Ranges.*—All earthquake disturbances have probably a tendency to radiate in a uniform manner from their source, and are only prevented from doing so by meeting with heavy mountainous districts, which by their mass and structure absorb the energy communicated to them. Much energy is also lost by emergence on the open flanks of a range of mountains. Rather than say that high mountains often bound the extension of an earthquake, or that earthquakes appear to run along the flanks of such mountains, we might say that earthquakes have boundaries parallel to the strike of the rocks in a given district, that such a direction is the one in which the propagation is the easier.—MILNE *Earthquakes*, ch. 12, p. 230. (A., 1899.)

2277. MOUNTAINS OF ETERNAL LIGHT—At the lunar poles (where, moreover, we see neither snow nor ice) there are mountains so strangely situated that their summits know no night; the sun never sets on them. They may be called the mountains of eternal light.—FLAMMARION *Popular Astronomy*, bk. ii, ch. 4, p. 123. (A.)

2278. MOUNTAINS PILED BY VOLCANIC ERUPTIONS—*Caverns Hollowed beneath the Earth—Earthquakes Due to Collapse of Caverns.*—By the ejection of ashes and lava from volcanic vents an extensive evisceration of the neighboring ground might be expected. When we look at a volcano like Fujiyama, nearly 13,000 feet in height, and at least fifty miles in circumference, and remember that the mass of cinders and slag of which it is composed came from beneath the area on which it rests, the point to be wondered at is that earthquakes, consequent on the collapse of subterranean hollows, are not more frequent than they are. At the time of a single eruption of a volcano the quantity of lava ejected amounts to many thousand millions of cubic feet. In 1783 the quantity of lava ejected from Skaptar Jokul, in Iceland, was estimated as surpassing "in magnitude the bulk of Mont Blanc." . . . Beneath a volcano it is probable that viscous material immediately takes the place of that which is ejected, and that hollows are not formed as in the case of chemical degradation. If

a cavern becomes too large it eventually collapses.—MILNE *Earthquakes,* ch. 17, p. 285. (A., 1899.)

2279. MOUNTAINS SHATTERED—*Mountainsides Denuded—Rivers Checked—Fish Taken on Land.*—The Blue, and other of the highest mountains [in Jamaica, in the earthquake of 1692], are declared to have been strangely torn and rent. They appeared shattered and half naked, no longer affording a fine green prospect, as before, but stripped of their woods and natural verdure. The rivers on these mountains first ceased to flow for about twenty-four hours, and then brought down into the sea, at Port Royal and other places, several hundred thousand tons of timber, which looked like floating islands on the ocean. The trees were in general barked, most of their branches having been torn off in the descent. It is particularly remarked in this as in the narratives of so many earthquakes, that fish were taken in great numbers on the coast during the shocks. The correspondents of Sir Hans Sloane, who collected with care the accounts of eye-witnesses of the catastrophe, refer constantly to subsidences, and some supposed the whole of Jamaica to have sunk down.—LYELL *Principles of Geology,* bk. ii, ch. 29, p. 505. (A., 1854.)

2280. MOUNTAINS SNOW-CLAD—*Meaning of "Perpetual Snow"—Perpetual Change and Renewal.*—The term "perpetual snow" should not lead any one to suppose that there is any elevation at which snow, after falling, remains absolutely unchanged. All the snow that falls on the mountains, however high, is destined to disappear in course of time. It may gradually be forced down by the weight of new accumulations to levels at which it melts and runs away as water; it may be blown down to lower and warmer levels, and in this way great quantities of snow are removed by every high wind on snow-clad mountains: it may be melted by the heat of the sun far above the snow-line, or it may evaporate or disappear insensibly in the form of invisible vapor. . . .

It is not, then, because the snow that falls on the tops of mountains remains always the same, that there is a limit of perpetual snow on the highest mountains, even in the tropics. But this limit is that at which snow never altogether disappears before fresh snow has fallen to take its place. It is for that reason that it is not temperature alone that determines the height of the snow-line.—CHISHOLM *Nature-Studies,* p. 33. (Hum., 1888.)

2281. MOVEMENT, MOLECULAR, CONTAINS NO SUGGESTION OF CONSCIOUSNESS—The consensus of scientific opinion here is extraordinary. "I know nothing," says Huxley, in the name of biology, "and never hope to know anything, of the steps by which the passage from molecular movement to states of consciousness is effected." "The two things," emphasizes the physicist, "are on two utterly different platforms: the physical facts go along by themselves, and the mental facts go along by themselves." "It is all through and forever inconceivable," protests the German physiologist [Du Bois-Reymond], "that a number of atoms of carbon, hydrogen, nitrogen, oxygen, and so on, shall be other than indifferent as to how they are disposed and how they move, how they were disposed and how they moved, how they will be disposed and how they will be moved. It is utterly inconceivable how consciousness shall arise from their joint action." [Compare MOTION, ATOMIC, 2256.]—DRUMMOND *Ascent of Man,* ch. 4, p. 124. (J. P., 1900.)

2282. MOVEMENT OF A DAY CHANGES FACE OF THE EARTH—*Lava-stream Forming Lake—Plastic Current Hardens to Rock.*—A lava-stream may cross a valley so as to obstruct its drainage and cause a lake to form above it, in much the same way as glaciers dam lateral valleys. A large lake was formed in this manner, probably in Pleistocene times, on the Yukon River, Alaska, where it is joined by Pelly River. A series of lava-flows there filled the river valley from side to side to a depth of several hundred feet, and formed a dam which retained the waters of the Yukon, and gave origin to a broad water body known as Lake Yukon. The obstruction has since been cut through along the southern margin of the old channel, leaving a series of basaltic precipices on the right bank of the river.—RUSSELL *Lakes of North America,* ch. 1, p. 17. (G. & Co., 1895.)

2283. MOVEMENT OF ENTIRE SOLAR SYSTEM THROUGH SPACE—*Swiftness of the Motion—We Are Part of a Universal System.*—Sir W. Herschel first, and afterwards several other astronomers, have, by the careful study of the stars' movements, ascertained, with what amounts practically to absolute certainty, that our sun, with his whole family of planets, is moving towards the part of the heavens occupied by the constellation Hercules. Every investigation of the evidence has led to the same general result in this respect. . . . It has been said that the sun is traveling at the rate of three or four miles in every second of time. But when one examines the evidence one finds that this conclusion depends on assumptions as to the average real magnitude of the stars of various orders of apparent brightness. I was long since led to conclude that such assumptions were unsafe, and also to infer from certain evidence which I had collected that our sun moves much more swiftly than had been supposed.—PROCTOR *Expanse of Heaven,* p. 289. (L. G. & Co., 1897.)

2284. MOVEMENT OF MUTILATED ANIMAL—*Reflex Action Becomes Purely Mechanical.*—Surely the reasoning is bad which argues that because a given movement goes

on after the animal has been mutilated, this movement must therefore continue to possess all the same elements of character which accompanied it when the animal was complete. And not only is the reasoning bad, but as a matter of fact the conclusion has been proved to be erroneous. Farther investigations have shown that when the cerebral hemispheres have been removed the "reflex action" in a frog's leg acquires a new character. It becomes a mere result of physical causation, and is consequently as certain and inevitable as the action of a coiled spring. Accordingly, it can be predicted and foreseen with certainty. In short, the mental element has been eliminated along with that part of the machinery which is the organ of consciousness and will. But when that part of the machinery remains untouched, then "reflex action" loses its character of necessity as the result of mere mechanical causation. It cannot be predicted with certainty, because altho the "stimulus" may be the same, and the animal impulse may be the same, there is a controlling apparatus to which has been given the free and incalculable power of resisting both stimulus and impulse. Both parts of the apparatus are equally machinery. But the one has a mental function, and the other has a function purely physical.—ARGYLL *Unity of Nature*, ch. 3, p. 65. (Burt.)

2285. MOVEMENT, SUSTAINED, WITH SLIGHT EXERTION—*The Condor's Flight.*—When the condors are wheeling in a flock round and round any spot, their flight is beautiful. Except when rising from the ground I do not recollect ever having seen one of these birds flap its wings. Near Lima I watched several for nearly half an hour without once taking off my eyes: they moved in large curves, sweeping in circles, descending and ascending without giving a single flap. As they glided close over my head I intently watched from an oblique position the outlines of the separate and great terminal feathers of each wing: and these separate feathers, if there had been the least vibratory movement, would have appeared as if blended together; but they were seen distinct against the blue sky. The head and neck were moved frequently and apparently with force; and the extended wings seemed to form the fulcrum on which the movements of the neck, body, and tail acted. If the bird wished to descend, the wings were for a moment collapsed; and when again expanded with an altered inclination the momentum gained by the rapid descent seemed to urge the bird upwards with the even and steady movement of a paper kite. In the case of any bird soaring, its motion must be sufficiently rapid so that the action of the inclined surface of its body on the atmosphere may counterbalance its gravity. The force to keep up the momentum of a body moving in a horizontal plane in the air (in which there is so little friction) cannot be great, and this force is all that is wanted. The movement of the neck and body of the condor, we must suppose, is sufficient for this. However this may be, it is truly wonderful and beautiful to see so great a bird, hour after hour, without any apparent exertion, wheeling and gliding over mountain and river.—DARWIN *Naturalist's Voyage around the World*, ch. 9, p. 186. (A., 1898.)

2286. MOVEMENT UNIVERSAL IN PLANTS—*Generally Spiral in Character—Circumnutation.*—The most widely prevalent movement is essentially of the same nature as that of the stem of a climbing plant, which bends successively to all points of the compass, so that the tip revolves. This movement has been called by Sachs "revolving nutation"; but we have found it much more convenient to use the terms *circumnutation* and *circumnutate.* As we shall have to say much about this movement, it will be useful here briefly to describe its nature. If we observe a circumnutating stem, which happens at the time to be bent, we will say, towards the north, it will be found gradually to bend more and more easterly, until it faces the east; and so onwards to the south, then to the west, and back again to the north. If the movement had been quite regular the apex would have described a circle, or rather, as the stem is always growing upwards, a circular spiral. But it generally describes irregular elliptical or oval figures; for the apex, after pointing in any one direction, commonly moves back to the opposite side, not, however, returning along the same line. Afterwards other irregular ellipses or ovals are successively described, with their longer axes directed to different points of the compass. Whilst describing such figures the apex often travels in a zigzag line, or makes small subordinate loops or triangles. In the case of leaves the ellipses are generally narrow.—DARWIN *Power of Movement in Plants*, ch. 1, p. 1. (A., 1900.)

2287. ———— ———— *New Results Reached by Ceaseless Striving—Effects of Circumnutation.*—Apparently every growing part of every plant is continually circumnutating [see 2286], tho often on a small scale. Even the stems of seedlings before they have broken through the ground, as well as their buried radicles, circumnutate, as far as the pressure of the surrounding earth permits. In this universally present movement we have the basis or groundwork for the acquirement, according to the requirements of the plant, of the most diversified movements. Thus, the great sweeps made by the stems of twining plants, and by the tendrils of other climbers, result from a mere increase in the amplitude of the ordinary movement of circumnutation. The position which young leaves and other organs ultimately assume is acquired by the

circumnutating movement being increased in some one direction. The leaves of various plants are said to sleep at night, and it will be seen that their blades then assume a vertical position through modified circumnutation, in order to protect their upper surfaces from being chilled through radiation. The movements of various organs to the light, which are so general throughout the vegetable kingdom, and occasionally from the light, or transversely with respect to it, are all modified forms of circumnutation, as again are the equally prevalent movements of stems, etc., towards the zenith, and of roots towards the center of the earth.—DARWIN *Power of Movement in Plants*, ch. 1, p. 3. (A., 1900.)

2288. MOVEMENTS, AUTOMATIC—*Education Makes Reflex Action Habitual and Easy—Superfluous Activity Eliminated.*—In our first attempts to write, to cipher, to play on an instrument, to speak, or in any other work of mechanical skill, the inward sense of labor and difficulty is corresponded to by the number of awkward and irrelevant gesticulations. On the other hand, in the last stage of consummated facility and routine, the consciousness is almost nothing; and the general quietude of the body demonstrates that the course of power has now become narrowed to the one channel necessary for the exact movements required. This is a sort of educated imitation of the primitive reflex movement adduced at the outset; the comparison is so striking as to suggest to physiologists the designation of secondary reflex or automatic for the habitual movements. A man at a signal-post, after long habit, is subjected to little or no nervous influence, except in the single thread of connection between a certain figure depicted on the eye and a certain movement of the hand; the collaterals of the primitive wave have died away, and the accompanying consciousness has fallen to a barely discernible trace.—BAIN *Mind and Body*, ch. 4, p. 14. (Hum., 1880.)

2289. ——— ——— *Mental Association Tends to Repeat Itself—Greek Verbs Learned by Hearing Recitation.*—A series of movements repeated in a certain order tend to unroll themselves with peculiar ease in that order forever afterward. Number one awakens number two, and that awakens number three, and so on, till the last is produced. A habit of this kind once become inveterate may go on automatically. And so it is with the objects with which our thinking is concerned. With some persons each note of a melody, heard but once, will accurately revive in its proper sequence. Small boys at school learn the inflections of many a Greek noun, adjective, or verb from the reiterated recitations of the upper classes falling on their ear as they sit at their desks. All this happens with no voluntary effort on their part, and with no thought of the spelling of the words.—JAMES *Psychology*, vol. i, ch. 14, p. 554. (H. H. & Co., 1899.)

2290. ——— ——— *Muscular Activities Repressed or Reenforced by Volition—Fatigue Requires Exertion of the Will.*—Each individual movement [in walking] suggests the succeeding one, and the repetition continues until, the attention having been recalled, the automatic impulse is superseded by the control of the will. Further, the direction of the movement is given by the sense of sight, which so guides the motions of our legs that we do not jostle our fellow-passengers or run up against lamp-posts; and the same sense directs also their general course along the line that habit has rendered most familiar, altho at the commencement of our walk we may have intended to take some other. Suppose our walk to be so prolonged, however, that the sense of fatigue comes on before we have reached its appointed conclusion. This calls off our attention from what is going on in the mind to the condition of the body; and in order to sustain the movements of locomotion a distinct exertion of the will comes to be requisite for each. With the increasing sense of fatigue an increased effort becomes necessary, and at last even the most determined volition may find itself unable to evoke a respondent movement from the exhausted muscles.—CARPENTER *Mental Physiology*, bk. i, ch. 1, § 16, p. 18. (A., 1900.)

2291. ——— ——— *Voluntary and Involuntary Activity Combined—Walking, Running, Writing, Etc., Done Chiefly by Reflex Action—Volition May Become a Hindrance.*—Reflex acts performed under the influence of the reflecting power of the spinal cord are essentially independent of the brain, and may be performed perfectly when the brain is separated from the cord. [It may be affirmed] that these include a much larger number of the natural and purposive movements of the lower animals than of the warm-blooded animals and man; and that over nearly all of them the mind may exercise, through the higher nerve-centers, some control, determining, directing, hindering, or modifying them, either by direct action, or by its power over associated muscles.

To these instances of spinal reflex action some add yet many more, including nearly all the acts which seem to be performed unconsciously, such as those of walking, running, writing, and the like, for these are really involuntary acts. It is true that at their first performances they are voluntary, that they require education for their perfection, and are at all times so constantly performed in obedience to a mandate of the will that it is difficult to believe in their essentially involuntary nature. But the will really has only a controlling power over their performance; it can hasten or stay them, but it has little or nothing to

do with the actual carrying out of the effect. And this is proved by the circumstance that these acts can be performed with complete mental abstraction; and, more than this, that the endeavor to carry them out entirely by the exercise of the will is not only not beneficial, but positively interferes with their harmonious and perfect performance. Any one may convince himself of this fact by trying to take each step as a voluntary act in walking down-stairs, or to form each letter or word in writing by a distinct exercise of the will.—BAKER *Handbook of Physiology,* vol. ii, ch. 18, p. 102. (W. W., 1885.)

2292. MOVEMENTS OF EARTH'S CRUST—*"Terra Firma" a Delusion.*—The folds and corrugations of the strata and the numerous dislocations by which rocks of all kinds are traversed clearly demonstrate that movements of the solid crust have taken place. Such crustal disturbances are probably in chief measure due to the fact that the earth is a cooling body. As the solid crust sinks down upon the cooling and contracting nucleus, it must occupy less superficial space. Hence its rocky framework becomes subjected to enormous tangential squeezing and compression, to which it yields by bending and folding, by fracture and displacement.—GEIKIE *Earth Sculpture,* ch. 1, p. 13. (G. P. P., 1898.)

2293. MOVEMENTS OF FLYING-FISH—*A True Flight—Fear Drives the Fish into Alien Element of Air.*—I have had frequent occasions to observe the flying-fishes attentively. I am confident not only that they change the direction of their flight, but that they raise or lower their line of movement repeatedly, without returning to the water. I avoid the word "falling" designedly, for all the acts of these fishes during their flight seem to me completely voluntary. They raise themselves from the surface of the water by rapidly repeated blows with the tail, and more than once have I seen them descend again to the surface of the water in order to repeat this movement; thus renewing the impulse and enabling themselves to continue for a longer time their passage through the air. Their changes of direction, either to the right and left or in rising and descending, are not due to the beating of the wings, that is to say, of the great pectoral fins, but simply to an inflection of the whole surface, in one or the other direction, by the contraction of the muscles controlling the action of the fin-rays, their pressure against the air determining the movement. The flying-fish is in fact a living shuttlecock, capable of directing its own course by the bending of its large fins. It probably maintains itself in the air until the necessity of breathing compels it to return to the water. The motive of its flight seems to me to be fear; for it is always in the immediate neighborhood and in front of the vessel that they are seen to rise; or perhaps at a distance when they are pursued by some large fish.—AGASSIZ *Journey in Brazil,* ch. 2, app., p. 522. (H. M. & Co., 1896.)

2294. MOVEMENTS OF MUSCLES ASSIGNED TO CENTERS IN THE BRAIN—Dr. R. W. Amidon in 1880 [succeeded in localizing] the heat produced [in the brain] by voluntary muscular contractions. Applying a number of delicate surface-thermometers simultaneously against the scalp, he found that when different muscles of the body were made to contract vigorously for ten minutes or more, different regions of the scalp rose in temperature, that the regions were well localized, and that the rise of temperature was often considerably over a Fahrenheit degree. As a result of his investigations he gives a diagram in which numbered regions represent the centers of highest temperature for the various special movements which were investigated. To a large extent they correspond to the centers for the same movements assigned by Ferrier and others on other grounds; only they cover more of the skull.—JAMES *Psychology,* vol. i, ch. 3, p. 100. (H. H. & Co., 1899.)

2295. MOVEMENTS WITH REFERENCE TO ENDS—*A Faculty of Plants as Well as of Animals—Venus's Fly-trap—Climbing Tendril.*—The faculty of making movements in reference to ends, affirmed of animals, was long denied to plants. . . . To show the breaking-down of the distinction, it would suffice to contrast the rooted fixity and vegetative growth of very many lower animals with the free locomotion of most microscopic aquatic plants and of the germs of those not microscopic. Is there not an independent movement, in response to an external impression, and in reference to an end, when the two sides of the trap of *Dionæa* [or Venus's fly-trap] suddenly enclose an alighted fly, cross their fringe of marginal bristles over the only avenue of escape, remain quiescent in this position long enough to give a small fly full opportunity to crawl out, soon open if this happens, but after due interval shut down firmly upon one of greater size which cannot get out, then pour out digestive juices, and in due time reabsorb the whole? So, . . . when a free revolving tendril avoids winding up itself uselessly around the stem it belongs to . . . by changing from the horizontal to the vertical position until it passes by it, and then rapidly resumes its horizontal sweep, to result in reaching a distant support—is it possible to think that these are not movements in reference to ends?—ASA GRAY *Natural Science and Religion,* lect. 1, p. 22. (S., 1891.)

2296. MULTIPLICATION BY DIVISION AMONG BACTERIA—Division, or fission, is the commonest method of reproduction [of bacteria]. It occurs transversely. A small indentation occurs in the capsule, which appears to make its way slowly through the whole body of the bacillus or micrococcus

until the two parts are separate, and each contained in its own capsule.—NEWMAN *Bacteria*, ch. 1, p. 16. (G. P. P., 1899.)

2297. MULTIPLICATION, INCONCEIVABLY RAPID, OF BACTERIA—Simple fission requires but a short period of time to be complete. Hence multiplication is very rapid, for within half an hour a new adult individual can be produced. It has been estimated that at this rate one bacillus will in twenty-four hours produce 17,000,000 similar individuals; or, expressed in another way, Cohn calculated that in three days, under favorable circumstances, this rate of increase would form a mass of living organisms weighing 7,300 tons, and numbering about 4,772 billions. Favorable conditions do not occur, fortunately, to allow of such increase, which, of course, can only be roughly estimated. But the above figures illustrate the enormous fertility of micro-organic life. When we remember that in some species it requires 10,000 or 15,000 fully grown bacilli placed end to end to stretch the length of an inch, we see also how exceedingly small are the individuals composing these unseen hosts.—NEWMAN *Bacteria*, ch. 1, p. 16. (G. P. P., 1899.)

2298. MULTIPLICATION OF PESTS—*Unintended Results of Commerce.*—Sometimes we unintentionally promote the multiplication of inimical species, as when we introduced the rat, which was not indigenous in the New World, into all parts of America. They have been conveyed over in ships, and now infest a great multitude of islands and parts of that continent. In like manner the Norway rat *(Mus decumanus)* has been imported into England, where it plunders our property in ships and houses. —LYELL *Geology*, ch. 39, p. 663. (A., 1854.)

2299. MULTITUDE OF BIRDS BY NIGHT IN UPPER AIR—*Telescope Reveals Them against the Moon.*—Some idea may be formed of the multitude of birds which throng the upper air on favorable nights, during their migration, by using a telescope. One having a two-inch object-glass will answer the purpose. It should be focused on the moon when the birds in passing are silhouetted against the glowing background. At the proper focal distance they appear with startling distinctness. In some cases each wing-beat can be detected, and with a large glass it is even possible to occasionally recognize the kind of bird. — CHAPMAN *Bird-Life*, ch. 4, p. 56. (A., 1900.)

2300. MUSEUM, ANCIENT, OF NATURAL CURIOSITIES — *Cooperation of Conqueror and Philosopher—Alexander Aids Aristotle—The Lykeum at Athens.*—In the spring of B. C. 334, Alexander of Macedon crossed the Hellespont and began the famous campaign which left him master of all the countries between the Danube and the Ganges. At about the same time Aristotle, who had been his preceptor, established a school at the Lykeum at Athens, and began to gather collections of plants, animals, and minerals, wherewith he illustrated his lectures, delivered while walking up and down the leafy paths which wound through the adjacent gardens. In this undertaking he found in his powerful disciple a most willing ally; for Alexander not only contributed a vast sum of money for the purchase of rare objects, but employed thousands of men to collect and transport to Athens all that was strange to the Greeks in the distant countries which had yielded to his arms.

To the gathering of this stupendous mass of material may be traced three results of the highest import: first, the acquisition of the multitudinous physical facts which fill the Aristotelian treatises on natural sciences; second, the foreshadowing of the inductive method of reasoning; third, the production by Theophrastus, the Lesbian, of a history of stones, probably based directly upon the study of Aristotle's collections.—PARK BENJAMIN *Intellectual Rise in Electricity*, ch. 2, p. 38. (J. W., 1898.)

2301. MUSIC, NATURAL INSTRUMENTS OF—*The Wood-cricket of Brazil (the Tananá)—Contrivance as of Violin and Bow.*—A strange kind of wood-cricket is found in this neighborhood, the males of which produce a very loud and not unmusical noise by rubbing together the overlapping edges of their wing-cases. The notes are certainly the loudest and most extraordinary that I ever heard produced by an orthopterous insect. The natives call it the *Tananá*, in allusion to its music, which is a sharp, resonant stridulation resembling the syllables "ta-na-ná, ta-na-ná," succeeding each other with little intermission. It seems to be rare in the neighborhood. When the natives capture one they keep it in a wicker-work cage for the sake of hearing it sing. A friend of mine kept one six days. It was lively only for two or three, and then its loud note could be heard from one end of the village to the other. When it died he gave me the specimen, the only one I was able to procure. It is a member of the family *Locustidæ*, a group intermediate between the crickets *(Achetidæ)* and the grasshoppers *(Acridiidæ)*. The total length of the body is two inches and a quarter; when the wings are closed the insect has an inflated vesicular or bladder-like shape, owing to the great convexity of the thin but firm parchmenty wing-cases, and the color is wholly pale green. The instrument by which the tananá produces its music is curiously contrived out of the ordinary nervures of the wing-cases. In each wing-case the inner edge, near its origin, has a horny expansion or lobe: on one wing this lobe has sharp raised margins; on the other the strong nervure which traverses the lobe on the other side is crossed by a number of fine sharp furrows like those of a file. When

the insect rapidly moves its wings the file of the one lobe is scraped sharply across the horny margin of the other, thus producing the sounds, the parchmenty wing-cases and the hollow drumlike space which they enclose assisting to give resonance to the tones.—BATES *The Naturalist on the River Amazon*, ch. 6, p. 672. (Hum., 1880.)

2302. MUSIC OF PRIMITIVE WOMAN —*Domestic and Maternal Type Controls.*—It was with genuine pleasure that the author heard Mr. Cushing say that the women of Zuñi, tho they never play upon any of the musical instruments of the tribe, sing songs of their own, which are invariably associated with domestic and industrial pursuits. As they nurse their children they croon a lullaby, and more novel than that are the little melodies which they chant as they plant the corn or beans or melons to encourage their growth. The theory of the Zuñi woman seems to be that there is some mysterious connection between the voices or sounds of things and their increase. When she kneels by her stone bread-making trough she sings a song which has many little imitations of the mealing-stone. The theory in her mind is that the implement will do far better work under those circumstances. It is the same when she sings to her baby. Her boy she calls her little man, and speaks of all she hopes he may become, believing that these are necessary to his growth. This serious intent goes through all her music.—MASON *Woman's Share in Primitive Culture*, ch. 8, p. 176. (A., 1894.)

2303. MUSIC, PLAINTIVE—*Melancholy Appeals to the Common People.*—Even on joyous occasions the lower classes love melodies that are mournful, and their music in general tends to plaintive feelings and melancholy.—FLACH *Der Tanz bei den Griechen (a Lecture)*. (Translated for *Scientific Side-Lights.*)

2304. MYRIADS OF SUNS—*One Hundred Million Stars.*—We find for the total of stars down to the 14th magnitude inclusive the number, already difficult to imagine, of *forty-four millions.*

But these are not *all* the stars. Already even the powerful telescopes constructed in recent years have penetrated the depths of immensity so far as to discover stars of the 15th magnitude, and the stellar statistics have now risen to *one hundred millions!* Celestial photography penetrates further still, and the numbers become so enormous that we are overwhelmed by their weight without understanding them.

One hundred millions of stars! This gives 17,000 stars for each of those which we see with the naked eye—seventeen times more than we can count in both hemispheres. We shall shortly estimate the distances which separate them, and the incomparable space over which their empire extends.

One hundred millions of suns similar to ours, and surrounded by worlds counted by thousands of millions! These are, unquestionably, very amazing numbers, and it would not be surprising if they should not be at once realized in their prodigious magnitude by our brains, unaccustomed to such enormous figures. We may remark, however, in passing, that a number well understood tells more than the finest phrases.—FLAMMARION *Popular Astronomy*, bk. vi, ch. 4, p. 587. (A.)

2305. MYSTERIES OF ARCHEOLOGY —*A Race Vanished without a Record.*—When, why, or by whom [the mounds of North America] were erected as yet we know not. The Indian tribes, tho they look upon them with reverence, have thrown no light upon their origin. Nor do the contents of the mounds themselves assist us in this inquiry. Several of them have been opened, and in making the streets of Milwaukee many of the mounds have been entirely removed; but the only result has been to show that they are not sepulchral, and that, excepting by accident, they contain no implements or ornaments. *

Under these circumstances speculation would be useless; we can but wait, and hope that time and perseverance may solve the problem, and explain the nature of these remarkable and mysterious monuments.—AVEBURY *Prehistoric Times*, ch. 8, p. 257. (A., 1900.)

2306. MYSTERY AMID THE MOUNTAINS—*Lake without Tributary or Outlet—Crater Lake—A Mountain Peak Obliterated.* —Crater Lake has been described by C. E. Dutton, and is considered by him as worthy of a high rank among the wonders of the world. It is situated in the Cascade Mountains, in northwestern Oregon, thirty miles north of Klamath Lake, at an elevation of 6,239 feet above the sea. It is nearly circular, without bays or promontories, . . . and is from five to six miles in diameter. The cliffs of dark basaltic rock encircling it rise precipitously to heights varying from 900 to 2,200 feet, and nowhere offer an easy means of access to the basin within. They plunge at once into deep water, without leaving even a platform at the water's edge wide enough for one to walk on. There are no streams tributary to the lake, and no visible outlet. The waters probably escape by percolation, as the precipitation of the region is in excess of evaporation, and if an escape were not furnished the basin would be filled to overflowing. . . .

The sounding-line has shown that Crater Lake has a maximum depth of 2,000 feet and is the deepest lake now known in North America, its nearest rival being Lake Tahoe. The full depth of the basin, measured from the crest of the enclosing cliffs, is from 2,900 to 4,200 feet. . . .

More remarkable, however, than the unique scenic features of Crater Lake is the story of its origin. The site of the great depression was once occupied by a volcanic

mountain which reached far above the highest point on the cliffs now enclosing it, and was probably as conspicuous a member of the sisterhood of mountains of which it formed a part as any of the neighboring peaks, but the once prominent pile has been removed so as to leave the profound gulf that now fascinates and startles the observer. The character of the sculpturing on the outer slope of the truncated mountain shows that it was eroded, both by streams and by glaciers, before the catastrophe that carried away its summit and left only a hollow stump to mark the site of the ice-crowned peak that formerly gleamed in the sky.—RUSSELL *Lakes of North America*, ch. 1, p. 20. (G. & Co., 1895.)

2307. MYSTERY AS TO CONSTITUTION OF THE EARTH—*An Unsolved Problem—No Dogmatism upon the Unknown.*—From this summary of the speculative views which have been entertained upon the subject of the physical condition of the earth's interior, it will be clear that at present we have not sufficient evidence for arriving at anything like a definite solution of the problem. The conditions of temperature and pressure which exist in the interior of a globe of such vast dimensions as our earth are so far removed from those which we can imitate in our experimental inquiries, and it is so unsafe to push the application of laws arrived at by the latter to the extreme limits required by the former, that we shall do well to pause before attempting to dogmatize on such a difficult question.—JUDD *Volcanoes*, ch. 11, p. 329. (A., 1899.)

2308. MYSTERY AWAITING SOLUTION—*Science Ever Looks toward the Future.*—It is believed that we understand how the more compact and stonelike variety of tuff was deposited, since similar accumulations are formed where waters saturated with calcium carbonate deposit that salt on account of the loss of carbonic acid. The dendritic tuff may also have been precipitated in a similar manner, or perhaps through the agency of low forms of plant life. The mode of origin of the tuff with well-defined crystals, however, is still unknown, altho both geologists and chemists have sought diligently to discover the secret of its formation. The open cellular structure of the crystals, as well as their forms, suggest that they are pseudomorphs: that is, having a false form, or a form not assumed by calcium carbonate on crystallizing, but resulting from the alteration or replacement of some other mineral. This suggestion only removes the difficulty one step farther, however, since the nature of the original mineral is still unknown.—RUSSELL *Lakes of North America*, ch. 6, p. 111. (G. & Co., 1895.)

2309. MYSTERY BEHIND EVOLUTION—*Cause Carried Further Back in Time.*—It [the evolutionary hypothesis] does not solve—it does not profess to solve—the ultimate mystery of this universe. It leaves, in fact, that mystery untouched. For, granting the nebula and its potential life, the question whence they came would still remain to baffle and bewilder us. At bottom the hypothesis does nothing more than "transport the conception of life's origin to an indefinitely distant past."—TYNDALL *Fragments of Science*, vol. ii, ch. 8, p. 133. (A., 1897.)

2310. MYSTERY EXPLAINED—*The Sinking of Great Stones through the Action of Worms.*—Farmers in England are well aware that objects of all kinds, left on the surface of pasture-land, after a time disappear, or, as they say, work themselves downwards. How powdered lime, cinders, and heavy stones can work down, and at the same rate, through the matted roots of a grass-covered surface, is a question which has probably never occurred to them. . . . When a stone of large size and of irregular shape is left on the surface of the ground, it rests, of course, on the more protuberant parts; but worms soon fill up with their castings all the hollow spaces on the lower side; for, as Hensen remarks, they like the shelter of stones. As soon as the hollows are filled up the worms eject the earth which they have swallowed beyond the circumference of the stones, and thus the surface of the ground is raised all round the stone. As the burrows excavated directly beneath the stone after a time collapse, the stone sinks a little. Hence it is that boulders which at some ancient period have rolled down from a rocky mountain or cliff on to a meadow at its base, are always somewhat embedded in the soil: and, when removed, leave an exact impression of their lower surfaces in the underlying fine mold. If, however, a boulder is of such huge dimensions that the earth beneath is kept dry, such earth will not be inhabited by worms, and the boulder will not sink into the ground.—DARWIN *Formation of Vegetable Mould*, ch. 3, p. 42. (Hum., 1887.)

2311. MYSTERY LIES BEHIND EVERY THEORY—*Limitations of Human Mind.*—It is very frequently said, in opposition to the transmutation theory [or development hypothesis], that it does indeed fully explain those phenomena by inheritance and adaptation, but that it does not at the same time explain these properties of organic matter, and that therefore we do not arrive at first causes. This objection is quite correct, but it applies equally to all explanations of phenomena. We nowhere arrive at a knowledge of first causes. The origin of every simple salt-crystal, which we obtain by evaporating its mother-liquor, is no less mysterious to us, as far as concerns its first cause, and in itself no less incomprehensible than the origin of every animal which is developed out of a simple cell. In explaining the most simple physical or chemical phenomena, as the falling of a

stone, or the formation of a chemical combination, we arrive, by discovering and establishing the active causes—for example, the gravitation or the chemical affinity—at other remoter phenomena, which in themselves are mysterious. This arises from the limitation or relativity of our powers of understanding. We must not forget that human knowledge is absolutely limited, and possesses only a relative extension. It is, in its essence, limited by the very nature of our senses and of our brains.—HAECKEL *History of Creation*, vol. i, ch. 2, p. 31. (K. P. & Co., 1899.)

2312. MYSTERY OF CHEMICAL ACTION — *Force Apparently Inoperative or Lost—Faith in Law Leads to New Discoveries.*—It is perfectly true that we cannot always trace a force by its actions, tho we admit its conservation. Oxygen and hydrogen may remain mixed for years without showing any signs of chemical activity; they may be made at any given instant to exhibit active results, and then assume a new state, in which again they appear as passive bodies. Now, tho we cannot clearly explain what the chemical force is doing, that is to say, what are its effects during the three periods before, at, and after the active combination, and only by very vague assumption can approach to a feeble conception of its respective states, yet we do not suppose the creation of a new portion of force for the active moment of time, or the less believe that the forces belonging to the oxygen and hydrogen exist unchanged in their amount at all these periods, tho varying in their results. A part may at the active moment be thrown off as mechanical force, a part as radiant force, a part disposed of we know not how; but believing, by the principle of conservation, that it is not increased or destroyed, our thoughts are directed to search out what at all and every period it is doing, and how it is to be recognized and measured. A problem, founded on the physical truth of Nature, is stated, and, being stated, is on the way to its solution.—FARADAY *The Conservation of Force* (in *Correlation and Conservation of Forces*), p. 380. (A., 1898.)

2313. MYSTERY OF CONSCIOUSNESS—*Memory Admits of No Explanation.*—A word, in closing, about the metaphysics involved in remembering. According to the assumptions of this book, thoughts accompany the brain's workings, and those thoughts are cognitive of realities. The whole relation is one which we can only write down empirically, confessing that no glimmer of explanation of it is yet in sight. That brains should give rise to a knowing consciousness at all, this is the one mystery which returns, no matter of what sort the consciousness and of what sort the knowledge may be.—JAMES *Psychology*, vol. i, ch. 16, p. 687. (H. H. & Co., 1899.)

2314. ——— ——— *Molecular Motion Cannot Explain Thought and Feeling—Two Incomprehensibles.*—Four years ago I wrote thus: "Do states of consciousness enter as links into the chain of antecedence and sequence which gives rise to bodily actions? Speaking for myself it is certain that I have no power of imagining such states interposed between the molecules of the brain and influencing the transference of motion among the molecules. The thing "eludes all mental presentation." Hence an iron strength seems to belong to the logic which claims for the brain an automatic action uninfluenced by consciousness. But it is, I believe, admitted by those who hold the automaton theory that states of consciousness are produced by the motion of the molecules of the brain; and this production of consciousness by molecular motion is to me quite as unpresentable to the mental vision as the production of molecular motion by consciousness. If I reject one result I must reject both. *I, however, reject neither,* and thus stand in the presence of two Incomprehensibles instead of one Incomprehensible." Here I secede from the automaton theory, tho maintained by friends who have all my esteem, and fall back upon the avowal which occurs with such wearisome iteration throughout the foregoing pages; namely, my own utter incapacity to grasp the problem.—TYNDALL *Fragments of Science*, vol. ii, ch. 15, p. 407. (A., 1900.)

2315. ——— ——— *The All-embracing Problem—Explanations that Do Not Explain.*—Why not "pool" our mysteries into one great mystery, the mystery that brain-processes occasion knowledge at all? It is surely no different mystery to feel myself by means of one brain-process writing at this table now, and by means of a different brain-process a year hence to remember myself writing. All that psychology can do is to seek to determine what the several brain-processes are. . . . But of "images reproduced," and "claiming to represent," and "put together by a unifying *actus,*" I have been silent because such expressions either signify nothing or they are only roundabout ways of simply saying that the past is known when certain brain conditions are fulfilled, and it seems to me that the straightest and shortest way of saying that is the best.—JAMES *Psychology*, vol. i, ch. 16, p. 689. (H. H. & Co., 1899.)

2316. MYSTERY OF EVIL—*Optimism of Leibnitz—Limitation of the Divine Power—Plato Finds Matter the Source of All Evil.*—Leibnitz, in his famous theory of optimism, argued that a perfect world is in the nature of things impossible, but that the world in which we live is the best of possible worlds. The limitation of the Creator's power is made somewhat more explicitly by Plato, who regarded the world as the imperfect realization of a divine idea that in itself is perfect. It is owing to the in-

tractableness and vileness of matter that the divine idea finds itself so imperfectly realized. Thus the Creator's power is limited by the nature of the material out of which he makes the world. In other words, the world in which we live is the best the Creator could make out of the wretched material at his disposal. Matter is endowed with a diabolical character of its own.—FISKE *Through Nature to God*, pt. i, ch. 3, p. 13. (H. M. & Co., 1900.)

2317. MYSTERY OF EVOLUTION —*Is Part of the Mystery of Life—Problems Unanswered.*—The process of organic evolution is far from being fully understood. We can only suppose that as there are devised by human beings many puzzles apparently unanswerable till the answer is given, and many necromantic tricks which seem impossible till the mode of performance is shown; so there are apparently incomprehensible results which are really achieved by natural processes. Or, otherwise, we must conclude that since life itself proves to be in its ultimate nature inconceivable, there is probably an inconceivable element in its ultimate workings.—SPENCER *Biology*, pt. iii, ch. 14A, p. 574. (A., 1900.)

2318. MYSTERY OF EXTENDED CONSCIOUSNESS—*Feeling through Tools and Implements.*—With the point of a cane we can trace letters in the air or on a wall just as with the finger-tip, and in so doing feel the size and shape of the path described by the cane's tip just as immediately as, without a cane, we should feel the path described by the tip of our finger. Similarly the draftsman's immediate perception seems to be of the point of his pencil, the surgeon's of the end of his knife, the duelist's of the tip of his rapier as it plunges through his enemy's skin. When on the middle of a vibrating ladder, we feel not only our feet on the round, but the ladder's feet against the ground far below. If we shake a locked iron gate we feel the middle, on which our hands rest, move, but we equally feel the stability of the ends where the hinges and the lock are, and we seem to feel all three at once. And yet the place where the contact is received is in all these cases the skin, whose sensations accordingly are sometimes interpreted as objects on the surface, and at other times as objects a long distance off.—JAMES *Psychology*, vol. ii, ch. 17, p. 37. (H. H. & Co., 1899.)

2319. MYSTERY OF FLIGHT—*Seeming Defiance of Gravitation.*—"The way of an eagle in the air" was one of the things of which Solomon said that "he knew it not." No wonder that the wise king reckoned it among the great mysteries of Nature! The force of gravitation, tho its exact measure was not ascertained till the days of Newton, has been the most familiar of all forces in all ages of mankind. How, then, in violation of its known effects could heavy bodies be supported upon the thin air, and be gifted with the power of sustaining and directing movements more easy, more rapid, and more certain than the movements of other animals upon the firm and solid earth? No animal motion in Nature is so striking or so beautiful as the

> Scythe-like sweep of wings, that dare
> The headlong plunge through eddying gulfs of air.
> —LONGFELLOW, *Wayside Inn.*

Nor will the wonder cease when, so far as the mechanical problem is concerned, the mystery of flight is solved. If we wish to see how material laws can be bent to purpose, we shall study this problem.—ARGYLL *Reign of Law*, ch. 3, p. 77. (Burt.)

2320. MYSTERY OF GEOLOGY—*Lake of Unexplained Origin—We Find It Amid the Mountains—Lake Basin Once the Bed of a Glacier.*—The sounding-line has shown that Lake Chelan is over eleven hundred feet deep, but its full depth remains to be determined. In several soundings made by the writer in its central and western portions, no bottom was reached at the depth indicated. The surface of the lake is but 950 feet above the sea, so that the bottom of the trough is below sea-level. . . .

How the great gash in the mountain, fully one hundred miles long, and now filled for more than a thousand feet in depth by the lake, was formed is not easy to explain. Previous to the birth of the present lake the valley was occupied by a large glacier which flowed through it and joined another great ice-stream in the cañon of the Columbia. The ice smoothed the precipices of rock and piled up moraines on the more gentle slopes at the east end of the valley, but that the main depression existed before the glacial invasion is evident and is in harmony with the histories of many other valleys in the Cordilleran region. The valley has a still more ancient history, and in Tertiary, or in part perhaps in pre-Tertiary times, was excavated in the hard granite, now seen in its enclosing walls by the slow wear of streams. It is a stream-cut channel, but where the stream rose that did the work, or whence it flowed, remains to be determined by a careful study of all the facts bearing on the problem.—RUSSELL *Lakes of North America*, ch. 4, p. 66. (G. & Co., 1895.)

2321. MYSTERY OF GLACIAL EPOCH—We have as yet no clue to the source of this great and sudden change of climate [that produced the Glacial epoch]. Various suggestions have been made, among others that formerly the inclination of the earth's axis was greater, or that a submersion of the continents under water might have produced a decided increase of cold; but none of these explanations are satisfactory, and science has yet to find any cause which accounts for all the phenomena connected with it. It seems, however, unquestionable that since the opening of the Tertiary Age a cosmic summer and winter have succeeded each other, during which a

tropical heat and an arctic cold have alternately prevailed over a great portion of the present temperate zone.—AGASSIZ *Geological Sketches*, ser. i, ch. 8, p. 210. (H. M. & Co., 1896.)

2322. ——— ——— The different explanations of this wide-spread refrigeration [of the Glacial epoch] are stated and briefly discussed. To account for it seems to me, in the present state of our knowledge, the most perplexing of all the problems which this epoch presents. — BONNEY *Ice-work, Present and Past*, pref., p. 9. (A., 1896.)

2323. MYSTERY OF HEREDITY—In the case of self-division, where the whole organism falls into two halves, in the formation of buds, where a considerable portion of the whole body, already more or less developed, separates from the producing individual, we easily understand that the forms and vital phenomena should be the same in the producing and produced organism. It is much more difficult to understand in the formation of germ-buds, and more difficult still in the formation of germ-cells, how this very small, quite undeveloped portion of the body, this group of cells, or this single cell, not only directly takes with it certain parental qualities into its independent existence, but also after its separation from the parental individual develops into a many-celled body, and in this repeats the forms and vital phenomena of the original producing organism.—HAECKEL *History of Creation*, vol. i, ch. 8, p. 199. (K. P. & Co., 1899.)

2324. MYSTERY OF INTERACTION OF MIND AND BRAIN—*Incorporation of the Two Impossible—Succession in Time—Interchange of Subject and Object.*—When, therefore, we talk of incorporating mind with brain we must be held as speaking under an important reserve or qualification. Asserting the union in the strongest manner, we must yet deprive it of the almost invincible association of union in place. An extended organism is the condition of our passing into a state where there is no extension. A human being is an extended and material mass, attached to which is the power of becoming alive to feeling and thought, the extreme remove from all that is material; a condition of trance wherein, while it lasts, the material drops out of view—so much so that we have not the power to represent the two extremes as lying side by side, as container and contained, or in any other mode of local conjunction. The condition of our existing thoroughly in the one is the momentary eclipse or extinction of the other.—BAIN *Mind and Body*, ch. 6, p. 34. (Hum., 1880.)

2325. MYSTERY OF LIFE—*Scientific Explanation Often Mere Restatement.*—Not to speak of the connection of the body and the mind, not to speak of the nature of life, or still more of the nature of death, the simplest questions connected with our own organization are unanswered and unanswerable. Science gives us no help, because the explanations which to it are ultimate are not ultimate at all to the faculties which seek for more light concerning them. The very language of science is, in this respect, often more deceptive than helpful, inasmuch as it is the fashion of scientific men to pass off as explanations the mere restatement of facts concealed under words derived from the dead languages. Perhaps it is all that they can do; but at least the poverty of the device should be seen and known. The "atoms" and the "molecules," the "cells" and the "differentiated structures," are these the builders, or are they only the bricks and stones? And the forces and the energies which work in these and upon these, what are they? And if these are undying and inexhaustible, how are all the forms in which they are embodied so fugitive and evanescent?—ARGYLL *Unity of Nature*, ch. 4, p. 77. (Burt.)

2326. MYSTERY OF LIGHT—*Its Motion Incomprehensible.*—What is the essential nature of light? How do we see the universe? How does a luminous body radiate, and by what vehicle do its rays reach our eyes? What are even these rays? Man has discussed this great problem for thousands of years. The ancients believed that the rays might be shot forth from our eyes to lay hold of objects far away; Newton thought, on the contrary, that objects emitted luminous particles which pass through space and strike our retina; Young and Fresnel have since shown that luminous bodies do not emit any material particle, but cause the surrounding fluid to vibrate, as a bell makes the air vibrate. This has led us to imagine as indispensable to the propagation of light a certain fluid named ether, which is extremely light, and disseminated through the whole of space.

Just as we see the circular waves of a piece of water succeed each other round the point where the water has been struck, as air condenses and dilates in spherical waves round the resounding tuning-fork, so the ethereal fluid which fills space gives birth to a series of spherical waves, succeeding each other all round a luminous body. The waves of water are transmitted so slowly that the eye easily follows their motion; those of air fly with the velocity of 1,100 feet per second, varying with the temperature and the density of the atmosphere; those of the ether pass through immensity with the dizzy velocity of 186,000 miles per second. The most marvelous fact is that every star, every sun in space, is the center of constant undulations, which thus perpetually cross each other through immensity, without ever being confused or mutually mingled. I confess, for my part, that this fact appears to me absolutely incomprehensible. — FLAMMARION *Popular Astronomy*, bk. iii, ch. 7, p. 316. (A.)

2327. MYSTERY OF ROENTGEN RAYS—*Their Nature Unexplained—Defy Refraction or Reflection.*—What is it that constitutes the difference between the Roentgen rays and rays of ordinary light in consequence of which the one are not refracted, or only in an infinitesimal degree, while the other are freely refracted? . . . How is it that light travels more slowly through refracting medium than through vacuum? There are different conjectures which have been advanced. One is that the ether within refracting media is more dense than the ether in free space. Another is that while the density is the same the elasticity is less. Then, there have been speculations as to the ether being loaded with particles of matter. —G. G. STOKES, quoted by BARKER in *Roentgen Rays*, essay 4, p. 58. (H., 1899.)

2328. MYSTERY OF SLEEP—*Awe-inspiring Contrast to Waking Life.*—There is the mystery of sleep, which quietly shuts all the avenues of sense and so isolates the mind from contact with the world outside. To gaze at the motionless face of a sleeper temporarily rapt from the life of sight, sound, and movement—which, being common to all, binds us together in mutual recognition and social action—has always something awe-inspiring. This external inaction, this torpor of sense and muscle, how unlike to the familiar waking life, with its quick responsiveness and its overflowing energy!—SULLY *Illusions*, ch. 7, p. 127. (A., 1897.)

2329. MYSTERY OF THE SEAT OF THE SOUL—*Relation of Consciousness to Space.*—This is the problem known in the history of philosophy as the question of the seat of the soul. It has given rise to much literature, but we must ourselves treat it very briefly. Everything depends on what we conceive the soul to be, an extended or an inextended entity. . . .

The truth is that if the thinking principle is extended we neither know its form nor its seat, whilst if unextended it is absurd to speak of its having any space-relations at all.—JAMES *Psychology*, vol. i, ch. 8, p. 214. (H. H. & Co., 1890.)

2330. MYSTERY OF THE SUN'S CORONA—*Spectroscope Fails to Solve—Finds There a Yet Unknown Gas.*—The spectroscope informs us that, in great part at least, the elements which exist in the lower regions of the solar atmosphere in the state of vapor are metals we are familiar with upon the earth, while it shows the chromosphere and prominences to consist mainly of hydrogen and helium, and makes it possible to observe them even when the sun is not hidden by the moon. The secret of the corona it fails to unlock as yet, tho it informs us of the presence in it of an unknown gas of inconceivable tenuity.—YOUNG *The Sun*, int., p. 8. (A., 1898.)

2331. MYSTERY OF THE SUN'S UPLIFTING POWER—*Plants Built Up in Defiance of Gravitation.*—Did the reader ever consider that next to the mystery of gravitation, which draws all things on the earth's surface down, comes that mystery—not seen to be one because so familiar—of the occult force in the sunbeams which lifts things up? The incomprehensible energy of the sunbeam brought the carbon out of the air, put it together in the weed or the plant, and lifted each tree-trunk above the soil. The soil did not lift it, any more than the soil in Broadway lifted the spire of Trinity. Men brought stones there in wagons to build the church, and the sun brought the materials in its own way, and built up alike the slender shaft that sustains the grass-blade and the column of the pine. If the tree or the spire fell it would require a certain amount of work of men or horses or engines to set it up again. So much actual work, at least, the sun did in the original building, and if we consider the number of trees in the forest we see that this alone is something great.—LANGLEY *New Astronomy*, ch. 3, p. 72. (H. M. & Co., 1896.)

2332. MYSTERY OF THE UNIVERSE—*One or Many Systems?*—Is the visible universe organized in one or in several systems? . . . A problem so vast as this is still far from receiving even an approximate solution. From whatever point of view we consider it we find ourselves face to face with the infinite in space and time. The present aspect of the universe immediately brings into question its past and its future state, and then the whole of united human learning supplies us in this great research with but a pale light scarcely illuminating the first steps of the dark and unknown road on which we are traveling.—FLAMMARION *Popular Astronomy*, bk. vi, ch. 10, p. 652. (A.)

2333. MYSTERY OF VOLCANO AND EARTHQUAKE—*Boundary of Darkness around Circle of Light.*—I shall endeavor to point out . . . that the general tendency of subterranean movements, when their effects are considered for a sufficient lapse of ages, is eminently beneficial, and that they constitute an essential part of that mechanism by which the integrity of the habitable surface is preserved, and the very existence and perpetuation of dry land secured. Why the working of this same machinery should be attended with so much evil is a mystery far beyond the reach of our philosophy, and must probably remain so until we are permitted to investigate, not our planet alone and its inhabitants, but other parts of the moral and material universe with which they may be connected. Could our survey embrace other worlds, and the events, not of a few centuries only, but of periods as indefinite as those with which geology renders us familiar, some apparent contradictions might be reconciled, and some difficulties would doubtless be cleared up. But even then, as our capacities are finite,

while the scheme of the universe may be infinite, both in time and space, it is presumptuous to suppose that all sources of doubt and perplexity would ever be removed. On the contrary, they might, perhaps, go on augmenting in number, altho our confidence in the wisdom of the plan of Nature should increase at the same time; for it has been justly said that the greater the circle of light the greater the boundary of darkness by which it is surrounded.—LYELL *Principles of Geology*, bk. ii, ch. 29, p. 493. (A., 1854.)

2334. MYSTERY REMAINS EVEN TO THE MONIST—*The Riddle of the Universe Unread.*—We grant at once that the innermost character of Nature is just as little understood by us as it was by Anaximander and Empedocles twenty-four hundred years ago, by Spinoza and Newton two hundred years ago, and by Kant and Goethe one hundred years ago. We must even grant that this essence of substance becomes more mysterious and enigmatic the deeper we penetrate into the knowledge of its attributes, matter and energy, and the more thoroughly we study its countless phenomenal forms and their evolution. We do not know the "thing in itself" that lies behind these knowable phenomena.—HAECKEL *Riddle of the Universe*, concl., p. 380. (H., 1900.)

2335. MYSTERY, SCIENTIFIC — *A Zone of Darkness—The Unknown Everywhere Surrounds the Known.*—Lest this proclamation of mystery should seem alarming, let us add that this mystery also is scientific. The one subject on which all scientific men are agreed, the one theme on which all alike become eloquent, the one strain of pathos in all their writing and speaking and thinking, concerns that final uncertainty, that utter blackness of darkness bounding their work on every side. If the light of Nature is to illuminate for us the spiritual sphere, there may well be a black unknown, corresponding, at least at some points, to this zone of darkness round the natural world.—DRUMMOND *Natural Law in the Spiritual World*, int., p. 25. (H. Al.)

2336. MYSTERY SOLVED — *Comets' Tails Not Ethereal, but Subject to Ordinary Laws of Matter.*—The mystery of comets' tails has been to some extent penetrated; so far, at least, that by making certain assumptions strongly recommended by the facts of the case their forms can be, with very approximate precision, calculated beforehand. We have, then, the assurance that these extraordinary appendages are composed of no ethereal or supersensual stuff, but of matter such as we know it, and subject to the ordinary laws of motion, tho in a state of extreme tenuity. This is unquestionably one of the most remarkable discoveries of our time.—CLERKE *History of Astronomy*, pt. ii, ch. 11, p. 417. (Bl., 1893.)

2337. ——— ——— *Electric Repulsion the Producing Cause of Comets' Tails—Conflict of Forces.*—It is perfectly well ascertained that the energy of the push or pull produced by electricity depends (other things being the same) upon the *surface* of the body acted on; that of gravity upon its *mass*. The efficacy of solar electrical repulsion relatively to solar gravitational attraction grows, consequently, as the size of the particle diminishes. Make this small enough, and it will virtually cease to gravitate, and will unconditionally obey the impulse to recession. This principle Zöllner was the first to realize in its application to comets. It gives the key to their constitution. Admitting (as we seem bound to do) that the sun and they are similarly electrified, their more substantially aggregated parts will still follow the solicitations of his gravity, while the finely divided particles escaping from them will, simply by reason of their minuteness, fall under the sway of his repellent electric power. They will, in other words, form "tails." Nor is any extravagant assumption called for as to the intensity of the electrical charge concerned in producing these effects. Zöllner, in fact, showed that it need not be higher than that attributed by the best authorities to the terrestrial surface.—CLERKE *History of Astronomy*, pt. ii, ch. 11, p. 418. (Bl., 1893.)

2338. ——— ——— *Hospitals No Longer Charnel-houses—Exclusion of Bacteria Helps Surgeon and Patient.*—It was these organisms [bacteria] acting in wound and abscess which so frequently converted our hospitals into charnel-houses, and it is their destruction by the antiseptic system that now renders justifiable operations which no surgeon would have attempted a few years ago. The gain is immense to the practising surgeon as well as to the patient practised upon. Contrast the anxiety of never feeling sure whether the most brilliant operation might not be rendered nugatory by the access of a few particles of unseen hospital-dust, with the comfort derived from the knowledge that all power of mischief on the part of such dust has been surely and certainly annihilated.—TYNDALL *Floating Matter of the Air*, essay 5, p. 287. (A., 1895.)

2339. MYSTERY SURROUNDS FACTS OF SCIENCE—*The Great Ice Age Unexplained.*—It follows [from previous explanations] that the low temperature which undoubtedly prevailed during the Glacial Epoch has not yet received any satisfactory explanation. Each one that has been proposed is either inadequate or attended by grave difficulties. It is therefore probable that some factor which is essential for the complete solution of the problem is as yet undiscovered, or, at any rate, the importance of one which is already known has

not been duly recognized.—BONNEY *Ice-work, Present and Past*, pt. iii, ch. 2, p. 260. (A., 1896.)

2340. MYSTERY UNEXPLAINED—*Darwin's Conjecture Unfounded—The Eucalyptus on South-American Pampas.*—Scientists have not yet been able to explain why the pampas, with a humid climate and a soil exceedingly rich, have produced nothing but grass, while the dry, sterile territories on their north, west, and south borders have an arborescent vegetation. Darwin's conjecture that the extreme violence of the pampero, or southwest wind, prevented trees from growing, is now proved to have been ill-founded since the introduction of the *Eucalyptus globulus;* for this noble tree attains to an extraordinary height on the pampas, and exhibits there a luxuriance of foliage never seen in Australia.—HUDSON *Naturalist in La Plata*, ch. 1, p. 4. (C. & H., 1895.)

2341. MYSTERY UNFATHOMABLE—*Distances of Few Stars Known—Most Forever Unknown.*—Even the mighty instruments of our own day, wielded with all the skill and acumen which a long experience has generated, have not sufficed to enable us to measure the distances of more than about a dozen stars. Nor probably will it ever be possible for man to count by the hundred the number of stars whose distances are known. Of all the millions of stars revealed by the telescope, not the ten-thousandth part will have their true position in space assigned to them, however roughly. The real architecture of the stellar system must remain forever unknown to us, except as respects a relatively minute portion lying within certain limits of distance from the earth.—PROCTOR *Our Place among Infinities*, p. 188. (L. G. & Co., 1897.)

2342. MYTHOLOGY APPROPRIATED ANCIENT VOLCANOES—*The Forge of Vulcan.*—The ancients were acquainted only with the four or five active volcanoes in the Mediterranean area, the term "volcano" being the name of one of these (Vulcano, or Volcano, in the Lipari Islands), which has come to be applied to all similar phenomena. It is only in comparatively modern times that it has become a known fact that many hundreds of volcanoes exist upon the globe, and are scattered over almost every part of its surface. Classical mythology appropriated Vulcano as the forge of Hephæstus, and his Roman representative Vulcan, while Etna was regarded as formed by the mountains under which the vengeful deity had buried the rebellious Typhon; it may be imagined, therefore, that any endeavor to more closely investigate the phenomena displayed at these localities would be regarded not simply as an act of temerity, but as one of actual impiety.—JUDD *Volcanoes*, ch. 1, p. 3. (A., 1899.)

2343. MYTHOLOGY OF GREEKS—*The Simplicity of Nature Spoiled—Sense of Natural Beauty Fitfully Expressed.*—The Greek regarded the vegetable world as standing in a manifold and mythical relation to heroes and to the gods, who were supposed to avenge every injury inflicted on the trees and plants sacred to them. Imagination animated vegetable forms with life, but the types of poetry to which the peculiar direction of mental activity among the ancient Greeks limited them gave only a partial development to the descriptions of natural scenery. Occasionally, however, even in the writings of their tragic poets, a deep sense of the beauty of Nature breaks forth in animated descriptions of scenery in the midst of the most excited passions or the deepest tones of sadness. Thus, when Œdipus is approaching the grove of the Eumenides, the chorus sings, "the noble resting-place of the illustrious Colonos, where the melodious nightingale loves to tarry and pour forth its clear but plaintive note." Again it sings, "the verdant gloom of the thickly mantling ivy, the narcissus steeped in heavenly dew, the golden-beaming crocus, and the hardy and ever fresh-sprouting olive-tree." Sophocles strives to extol his native Colonos by placing the lofty form of the fated and royal wanderer by the brink of the sleepless waters of Cephisus, surrounded by soft and bright scenery. The repose of Nature heightens the impression of pain called forth by the image of the noble form of the blind sufferer, the victim of mysterious and fatal passion. Euripides also delights in picturesque descriptions of "the pastures of Messenia and Laconia, which, under an ever-mild sky, are refreshed by a thousand fountains and by the waters of the beautiful Pamisos."—HUMBOLDT *Cosmos*, vol. ii, pt. i, p. 25. (H., 1897.)

2344. MYTHS, DISAPPEARANCE OF, NO LOSS—*Science Makes Nature Not Less Grand—A Higher Poetry and a Mightier Philosophy.*—To a right-thinking and right-feeling mind, the beauty, the grandeur, the mystery of Nature are augmented, not lessened, by each new glimpse into the secret recesses of her operations. The sun going forth from its chamber in the east to run its course is not less glorious in majesty because we have discovered the law of gravitation, and are able by spectral analysis to detect the metals which enter into its composition—because it is no longer Helios driving his golden chariot through the pathless spaces of the heavens. The mountains are not less imposing in their grandeur because the oreads have deserted them, nor the groves less attractive nor the streams more desolate because science has banished the dryads and the naiads. No, science has not destroyed poetry, nor expelled the divine from Nature, but has furnished the materials and given the presages of a higher poetry and a mightier philosophy than the world has yet seen. The grave of each superstition which it slays is the womb of a better birth. And if it come

to pass in its onward march—as it may well be it will come to pass—that other superstitions shall be dethroned as the sun-god has been dethroned, we may rest assured that this also will be a step in human progress and in the beneficent evolution of the Power which ruleth alike the courses of the stars and the ways of men.—MAUDSLEY *Body and Mind*, lect. 3, p. 96. (A., 1898.)

2345. MYTHS, MODERN, MATCHING ANCIENT—*The Odyssey Finds Parallel in New Zealand.*—The Tahitians tell tales of their sea-god Hiro, whose followers were sailing on the ocean while he was lulled to sleep in a cavern in the depths below; then the wind-god raised a furious storm to destroy the canoe, but the sailors cried to Hiro, till, rising to the surface, he quelled the storm, and his votaries came safe to port. So in Homer, Poseidon the sea-god, dweller in caves of ocean, sets on the winds to toss the frail bark of Odysseus among the thundering waves, till Ino comes to his rescue and bids him strip and swim for the Phaiakian shore. Both tales are word-pictures of the stormy sea told in the language of nature-myths, only with different turns. The New Zealanders have a story of Maui imprisoning the winds, all but the wild west wind, whom he cannot catch to shut into its cavern by a great stone rolled against its mouth; all he can do is to chase it home sometimes, and then it hides in the cavern and for a while dies away. All this is a mythic description of the weather, meaning that other winds are occasional, but the west wind prevalent and strong. These New Zealanders had never heard of the classic myth of Æolus and the cave of the winds, yet how nearly they had come to the same mythic fancy, that it is from such blowholes in the hillsides that the winds come forth.—TYLOR *Anthropology*, ch. 15, p. 392. (A., 1899.)

2346. MYTHS OF ZOOLOGY—*Hairworms—Toads in Rock—Barnacle Geese—Popular Credulity Unlimited.*—When the country swain, loitering along some lane, comes to a standstill to contemplate, with awe and wonder, the spectacle of a mass of the familiar "hair-eels" or "hairworms" wriggling about in a pool, he plods on his way firmly convinced that, as he has been taught to believe, he has just witnessed the results of the transformation of some horse's hairs into living creatures. So familiar is this belief to people of professedly higher culture than the countryman, that the transformation just alluded to has to all, save a few thinking persons and zoologists, become a matter of the most commonplace kind. When some quarrymen, engaged in splitting up the rocks, have succeeded in dislodging some huge mass of stone, there may sometimes be seen to hop from among the débris a lively toad or frog, which comes to be regarded by the excavators with feelings akin to those of superstitious wonder and amazement. The animal may or may not be captured; but the fact is duly chronicled in the local newspapers, and people wonder for a season over the phenomenon of a veritable Rip Van Winkle of a frog, which, to all appearance, has lived for "thousands of years in the solid rock." Nor do the hairworm and the frog stand alone in respect of their marvelous origin. Popular zoology is full of such marvels. We find unicorns, mermaids, and mermen; geese developed from the shell-fish known as "barnacles"; we are told that crocodiles may weep, and that sirens can sing—in short, there is nothing so wonderful to be told of animals that people will not believe the tale.—ANDREW WILSON *Facts and Fictions of Zoology*, p. 1. (Hum., 1882.)

2347. ——— ——— *Ludicrous Fiction about the Skunk.*—In that not always trustworthy book, "The Natural History of Chili," Molina tells us how they deal with the animal in the transandine regions. "When one appears," he says, "some of the company begin by caressing it, until an opportunity offers for one of them to seize it by the tail. In this position the muscles become contracted, the animal is unable to eject its fluid, and is quickly despatched." One might just as well talk of caressing a cobra de capello; yet this laughable fiction finds believers all over South and North America. Professor Baird gravely introduces it into his great work on the mammalia. . . . The Indians are grave jokers, they seldom smile; and this old traditional skunk-joke, which has run the length of a continent, finding its way into many wise books, is their revenge on a superior race.—HUDSON *Naturalist in La Plata*, ch. 6, p. 118. (C. & H., 1895.)

2348. ——— ——— *Romantic Tales of the Gorilla—Inventions to Amuse Children.*—Mr. Ford discredits the house-building and elephant-driving stories [viz.: that the gorillas build houses to live in, and that bands of them unite, arm themselves with clubs, and drive elephants through the forest], and says that no well-informed natives believe them. They are tales told to children.—HUXLEY *Man's Place in Nature*, p. 212. (Hum.)

2349. ——— ——— *South-American Legend of a Tree-creeper's Nest.*—One species, *Erythrothorax*, in Yucatan, makes so large a nest of sticks, that the natives do not believe that so small a bird can be the builder. They say that when the *tzapatan* begins to sing, all the birds in the forest repair to it, each one carrying a stick to add to the structure; only one, a tyrant-bird, brings two sticks, one for itself and one for the *urubû* or vulture, that bird being considered too large, heavy, and ignorant of architecture to assist personally in the work.—HUDSON *Naturalist in La Plata*, ch. 18, p. 245. (C. & H., 1895.)

2350. MYTHS, ORIGIN OF—*Imagination among Barbarians—Supposed Remains of Giants.*—We know how strong our own desire is to account for everything. This desire is as strong among barbarians, and accordingly they devise such explanations as satisfy their minds. But they are apt to go a stage further, and their explanations turn into the form of stories with names of places and persons, thus becoming full-made myths. Educated men do not now consider it honest to make fictitious history in this way, but people of untrained mind, in what is called the myth-making stage, which has lasted on from the savage period and has not quite disappeared among ourselves, have no such scruples about converting their guesses at what may have happened into the most lifelike stories of what they say did happen. Thus, when comparative anatomy was hardly known, the finding of huge fossil bones in the ground led people to think they were the remains of huge beasts and enormous men, or giants, who formerly lived on the earth. Modern science decides that they were right as to the beasts, which were ancient species of elephant, rhinoceros, etc., but wrong as to the giants, none of the great bones really belonging to any creature like man. But while the belief lasted that they were bones of giants, men's imagination worked in making stories about these giants and their terrific doings, stories which are told still in all quarters of the globe as tho they were traditions of real events.—TYLOR *Anthropology*, ch. 15, p. 388. (A., 1899.)

2351. ——— ——— *Observer Held To Be Ruler of the Winds—Æolus Made a God.*—In the Lipari Islands there has prevailed a belief, from the very earliest period of history, that the feeble eruptions of Stromboli are in some way dependent upon the condition of the atmosphere. These islands were known to the ancients as the Æolian Isles, from the fact that they were once ruled over by a king of the name of Æolus. It seems not improbable that Æolus was gifted with natural powers of observation and reasoning far in advance of those of his contemporaries. A careful study of the vapor-cloud which covers Stromboli would certainly afford him information concerning the hygrometric condition of the atmosphere; the form and position assumed by this vapor-cloud would be a no less perfect index of the direction and force of the wind; and, if the popular belief be well founded, the frequence and violence of the explosions taking place from the crater would indicate the barometric pressure. From these data an acute observer would be able to issue "storm-warnings" and weather prognostics of considerable value. In the vulgar mind, the idea of the prediction of natural events is closely bound up with that of their production; and the shrewd weather-prophet of Lipari was after his death raised to the rank of a god, and invested with the sovereignty of the winds.—JUDD *Volcanoes*, ch. 2, p. 34. (A., 1899.)

2352. NAME, IMPORTANCE OF—*Science and Morality Unite—Redemption of the Drunkard.*—The hackneyed example of moral deliberation is the case of an habitual drunkard under temptation. He has made a resolve to reform, but he is now solicited again by the bottle. His moral triumph or failure literally consists in his finding the right name for the case. If he says that it is a case of not wasting good liquor already poured out, or a case of not being churlish and unsociable when in the midst of friends, or a case of learning something at last about a brand of whisky which he never met before, or a case of celebrating a public holiday, or a case of stimulating himself to a more energetic resolve in favor of abstinence than any he has ever yet made, then he is lost. His choice of the wrong name seals his doom. But if, in spite of all the plausible good names with which his thirsty fancy so copiously furnishes him, he unwaveringly clings to the truer bad name, and apperceives the case as that of "being a drunkard, being a drunkard, being a drunkard," his feet are planted on the road to salvation. He saves himself by thinking rightly.—JAMES *Talks to Teachers*, ch. 15, p. 187. (H. H. & Co., 1900.)

2353. NARROWNESS OF SPECIALIST—*Specialty Disqualifies for Comprehensive Reasonings.*—Science has in the course of its growth become divided into a great number of small specialties, each pursued ardently by its own votaries. This is beneficial in one respect; for much more can be gained by men digging downward, each on his own vein of valuable ore, than by all merely scraping the surface. But the specialist, as he descends fathom after fathom into his own mine, however rich and rare the gems and metals he may discover, becomes more and more removed from the ordinary ways of men, and more and more regardless of the products of other veins as valuable as his own. The specialist, however profound he may become in the knowledge of his own limited subject, is on that very account less fitted to guide his fellow men in the pursuit of general truth. When he ventures to the boundaries between his own and other domains of truth, or when he conceives the idea that his own little mine is the sole deposit of all that requires to be known, he sometimes makes grave mistakes; and these pass current for a time as the dicta of high scientific authority.—DAWSON *Facts and Fancies in Modern Science*, lect. 1, p. 17. (A. B. P. S.)

2354. NATION GREATER THAN COUNTRY—*Power and Influence of the Danes.*—Denmark occupies a larger space in the history than on the map of Europe; the nation is greater than the country. With the growth of physical power in surrounding populations, she has lost much of her influ-

ence in political councils, and has been recently deprived of a great part of her ancient possessions, but the Danes of to-day are no unworthy representatives of their ancestors. Many a larger nation might envy them the position they hold in science and art, and few have contributed more to the progress of human knowledge. Copenhagen may well be proud both of her museums and of her professors, and I would especially point to the celebrated Museum of Northern Antiquities as being most characteristic and unique.—AVEBURY *Prehistoric Times,* ch. 7, p. 213. (A., 1900.)

2355. NATURALISTS HAD REASONS FOR DENYING DEEP-SEA LIFE—*Fact Contradicts Reasonable Theory.*—It is not surprising that the naturalists of the early part of the present century could not believe in the existence of a fauna at the bottom of the deep seas. The extraordinary conditions of such a region—the enormous pressure, the absolute darkness, the probable absence of any vegetable life from want of direct sunlight—might very well have been considered sufficient to form an impassable barrier to the animals migrating from the shallow waters and to prevent the development of a fauna peculiarly its own.—HICKSON *Fauna of the Deep Sea,* ch. 2, p. 17. (A., 1894.)

2356. NATURE A COSMOS—*The Study of Ages.*—He who can trace, through bygone times, the stream of our knowledge to its primitive source, will learn from history how, for thousands of years, man has labored, amid the ever-recurring changes of form, to recognize the invariability of natural laws; and has thus, by the force of mind, gradually subdued a great portion of the physical world to his dominion. In interrogating the history of the past, we trace the mysterious course of ideas yielding the first glimmering perception of the same image of a cosmos, or harmoniously ordered whole, which, dimly shadowed forth to the human mind in the primitive ages of the world, is now fully revealed to the maturer intellect of mankind as the result of long and laborious observation.—HUMBOLDT *Cosmos,* vol. i, int., p. 23. (H., 1897.)

2357. NATURE AIDS INDUSTRIES—*Native Copper Waiting for Primitive Man to Pick Up.*—In the neighborhood of Lake Superior, and in some other still more northern localities, copper is found native in large quantities, and the Indians had therefore nothing to do but to break off pieces and hammer them into the required shape. Hearne's celebrated journey to the mouth of the Coppermine River, under the auspices of the Hudson's Bay Company, was undertaken in order to examine the locality whence the natives of that district obtained the metal. In this case it occurred in lumps actually on the surface, and the Indians seem to have picked up what they could, without attempting anything that could be called mining.—AVEBURY *Prehistoric Times,* ch. 8, p. 243. (A., 1900.)

2358. NATURE AN ARMORY—*Invariable Law Admits of Varying Adjustment—Will, Contrivance, and Purpose Find Place.*—Nature is a great armory of weapons and implements for the service and the use of will. Many of them are too ponderous for man to wield. He can only look with awe on the tremendous forces which are everywhere seen yoked under the conditions of adjustment—on the smoothness of their motions—on the magnitude and the minuteness, on the silence and the perfection, of their work. But there are also many weapons hung upon the walls which lend themselves to human hands—lesser tools which man can use. He cannot alter or modify them in shape or pattern, in quality or in power. The fashion of them and the nature of them are fixed forever. These are, indeed, invariable. Only if we know how to use them, then that use is ours. Then also the lesser contrivances which we can set in motion are ever found to work in perfect harmony with the vaster mechanisms which are moving overhead. And as in the material world no effort gives so fully the sense of work achieved as the subjugation of some natural force under the command of will, so in the world of mind no triumphs of the spirit are happier than those by which some natural tendency of human character is led to the accomplishment of a purpose which is wise and good.—ARGYLL *Reign of Law,* ch. 7, p. 227. (Burt.)

2359. NATURE ANTICIPATES HUMAN INVENTION—*The Bees Invented Canning.*—With their honey-cells sealed airtight, into which some observers believe that a drop of formic acid is injected, the bee folk were actually the first in the world to found a canning factory.—GLOCK *Die Symbolik der Bienen,* p. 20. (Translated for *Scientific Side-Lights.)*

2360. "NATURE" A PSEUDONYM FOR GOD—*An Intelligent Creative Mind.*—An able writer of the agnostic school, in a popular lecture on coal, . . . apostrophizes "Nature" as the cunning contriver who stored up this buried sunlight by her strange and mysterious alchemy, kept it quietly to herself through all the long geological periods when reptiles and brute mammals were lords of creation, and through those centuries of barbarism when savage men roamed over the productive coal-districts in ignorance of their treasures, and then revealed her long-hidden stores of wealth and comfort to the admiring study of science and civilization, and for the benefit of the millions belonging to densely peopled and progressive nations. It is plain that "Nature" in such a connection represents either a poetical fiction, a superstitious fancy, or an intelligent creative mind. It is further evident that such creative mind

must be in harmony with that of man, tho vastly greater in its scope and grasp in time and space.—DAWSON *Facts and Fancies in Modern Science*, lect. 5, p. 182. (A. B. P. S.)

2361. NATURE, BEAUTY AND VARIETY OF—*Natural Selection Not an Explanation.*—Now, what explanation does the law of natural selection give—I will not say of the origin, but even of the continuance and preservation—of such specific varieties as these [of humming-birds]? None whatever. A crest of topaz is no better in the struggle for existence than a crest of sapphire. A frill ending in spangles of the emerald is no better in the battle of life than a frill ending in the spangles of the ruby. A tail is not affected for the purposes of flight, whether its marginal or its central feathers are decorated with white. It is impossible to bring such varieties into relation with any physical law known to us. It has relation, however, to a purpose, which stands in close analogy with our own knowledge of purpose in the works of man. Mere beauty and mere variety, for their own sake, are objects which we ourselves seek when we can make the forces of Nature subordinate to the attainment of them. There seems to be no conceivable reason why we should doubt or question that these are ends and aims also in the forms given to living organisms, when the facts correspond with this view, and with no other. In this sense we can trace a creative law; that is, we can see that these forms of life do fulfil a purpose and intention which we can appreciate and understand.—ARGYLL *Reign of Law*, ch. 5, p. 139. (Burt.)

2362. NATURE, CALM OF, DELUSIVE—*Quiet Intervals of Volcanoes.*—While the volcano Stromboli (Strongyle) has been incessantly active since the Homeric ages, and has served as a beacon-light to guide the mariner in the Tyrrhenian Sea, loftier volcanoes have been characterized by long intervals of quiet. Thus we see that a whole century often intervenes between the eruptions of most of the colossi which crown the summits of the Cordilleras of the Andes.—HUMBOLDT *Cosmos*, vol. i, p. 229. (H., 1897.)

2363. NATURE DOES NOT EXPLAIN MAN—A glance at our logical behavior demonstrates that we cannot find the clue to human nature by considering man from the standpoint of natural science alone. Man is more than merely a product of Nature. An inner principle, the spiritual norm, following special laws of their own, are also determining factors.—SCHWARZ *Psychologie des Willens (a Lecture)*. (Translated for *Scientific Side-Lights.)*

2364. NATURE, EXTERNAL—*Perception of, Depends upon Mind of Observer.*—External Nature may be opposed to the intellectual world, as if the latter were not comprised within the limits of the former, or Nature may be opposed to art when the latter is defined as a manifestation of the intellectual power of man; but these contrasts, which we find reflected in the most cultivated languages, must not lead us to separate the sphere of Nature from that of mind, since such a separation would reduce the physical science of the world to a mere aggregation of empirical specialties. Science does not present itself to man until mind conquers matter in striving to subject the result of experimental investigation to rational combinations. Science is the labor of mind applied to Nature, but the external world has no real existence for us beyond the image reflected within ourselves through the medium of the senses. As intelligence and forms of speech, thought and its verbal symbols, are united by secret and indissoluble links, so does the external world blend almost unconsciously to ourselves with our ideas and feelings.—HUMBOLDT *Cosmos*, vol. i, int., p. 70. (H., 1897.)

2365. NATURE, HUMAN, KNOWLEDGE OF—*How Wise Men Learn.*—Confucius said (like Socrates): "I am not wise. But if any man, of humble condition, comes for information to me, who am empty, I make of him an object of research from every point, and exhaust him, while I enrich my own knowledge of human nature."—HAUG *Confucius der Weise (an Address* in *Virchow und Holtzendorf's Sammlung wissenschaftlicher Vorträge)*. (Translated for *Scientific Side-Lights.)*

2366. NATURE IGNORES MAN'S DIVIDING LINES—*Fauna of One Region Overlaps That of Another.*—In the study of the geographical distribution of terrestrial animals one of the great difficulties met with is the impossibility of defining exactly the limits of the regions into which we divide the surface of the earth. In a general way we recognize that there is an Australian region, an Ethiopian region, etc.; but, when we come to discuss the exact position of the frontier lines that separate these regions from their neighbors, we find all kinds of difficulties to overcome and inconsistencies to meet.

For the sake of convenience it is useful to adopt certain arbitrary limits for these regions, notwithstanding these difficulties and inconsistencies, but we must recognize the fact that Nature recognizes no such limits, that every region overlaps its neighbors to a greater or less extent, and that there are many debatable grounds in the world where the fauna characteristic of one region is mixed with that characteristic of another.—HICKSON *Fauna of the Deep Sea*, ch. 3, p. 45. (A., 1894.)

2367. NATURE IGNORES THE EXISTENCE OF MAN—*Drought and Volcano Regard Him Not.*—If the barren soil around Sydney had at once become fertile upon the landing of our first settlers; if, like the

happy isles whereof the poets have given such glowing descriptions, those sandy tracts had begun to yield spontaneously an annual supply of grain, we might then, indeed, have fancied alterations still more remarkable in the economy of Nature to have attended the first coming of our species into the planet. Or if, when a volcanic island like Ischia was, for the first time, brought under cultivation by the enterprise and industry of a Greek colony, the internal fire had become dormant, and the earthquake had remitted its destructive violence, there would then have been some ground for speculating on the debilitation of the subterranean forces, when the earth was first placed under the dominion of man. But after a long interval of rest the volcano bursts forth again with renewed energy, annihilates one-half of the inhabitants, and compels the remainder to emigrate. The course of Nature remains evidently unchanged; and, in like manner, we may suppose the general condition of the globe immediately before and after the period when our species first began to exist to have been the same, with the exception only of man's presence.—LYELL *Principles of Geology*, bk. i, ch. 9, p. 150. (A., 1854.)

2368. NATURE, INCITEMENTS TO STUDY OF—*Early Impressions Determine Life-work.*—In the simple consideration of the incitements to a scientific study of Nature, I would not omit calling attention to the fact that impressions arising from apparently accidental circumstances often —as is repeatedly confirmed by experience —exercise so powerful an effect on the youthful mind as to determine the whole direction of a man's career through life. The child's pleasure in the form of countries, and of seas and lakes, as delineated in maps; the desire to behold southern stars, invisible in our hemisphere; the representation of palms and cedars of Lebanon as depicted in our illustrated Bibles, may all implant in the mind the first impulse to travel into distant countries. If I might be permitted to instance my own experience, and recall to mind the source from whence sprang my early and fixed desire to visit the land of the tropics, I should name George Forster's "Delineations of the South Sea Islands," the pictures of Hodge, which represented the shores of the Ganges, and which I first saw at the house of Warren Hastings, in London, and a colossal dragontree in an old tower of the Botanical Garden at Berlin.—HUMBOLDT *Cosmos*, vol. ii, pt. i, p. 20. (H., 1897.)

2369. NATURE, MUNIFICENCE OF—*Power of Sun's Whole Radiance—Would Melt in One Instant an Ice-bridge That Reached to the Moon.*—Let us suppose that we could sweep up from the earth all the ice and snow on its surface, and, gathering in the accumulations which lie on its arctic and antarctic poles, commence building with it a tower greater than that of Babel, fiftee miles in diameter, and so high as to exhaus our store. Imagine that it could be pre served untouched by the sun's rays, whil we built on with the accumulations of suc cessive winters, until it stretched out 240,00 miles into space, and formed an ice-bridg to the moon, and that then we concentrate on it the sun's whole radiation, neithe more nor less than that which goes on ever moment. In one second the whole woul be gone, melted, boiled, and dissipated i vapor. And this is the rate at which th solar heat is being (to human apprehension wasted!—LANGLEY *New Astronomy*, ch. 4 p. 96. (H. M. & Co., 1896.)

2370. NATURE NAMED "MATTER—*Mystery Not the End of Inquiry—Aristotle on "the Divine."*—What is generall called Nature Professor Tyndall names mat ter—a peculiar nomenclature, requiring ne definitions (as he avers), inviting misun derstanding, and leaving the questions w are concerned with just where they were For it is still to ask: Whence this ricl endowment of matter? Whence comes tha of which all we see and know is the out come? That to which potency may in th last resort be ascribed, Professor Tyndall suspending further judgment, calls myster —using the word in one of its senses, name ly, something hidden from us which we ar not to seek to know. But there are als mysteries proper to be inquired into and t be reasoned about; and altho it may no be given unto us to *know* the mystery o causation, there can hardly be a more legiti mate subject of philosophical inquiry. Mos scientific men have thought themselves in tellectually authorized to have an opinio about it. "For, by the primitive and ver ancient men, it has been handed down i the form of myths, and thus left to late generations, that the *Divine* it is which hold together all Nature"; and this tradition, o which Aristotle, both naturalist and philosopher, thus nobly speaks—continued through succeeding ages, and illuminated by the light which has come into the world—may still express the worthiest thoughts of the modern scientific investigator and reasoner.—ASA GRAY *Darwiniana*, art. 13, p. 389. (A., 1889.)

2371. NATURE OF FORCE UNKNOWN—*Gravitation Ascribed to a Supreme Will.*—We know nothing of the ultimate nature or of the ultimate seat of force. Science, in the modern doctrine of the conservation of energy, and the convertibility of forces, is already getting something like a firm hold of the idea that all kinds of force are but forms or manifestations of some one central force issuing from some one fountainhead of power. Sir John Herschel has not hesitated to say that "it is but reasonable to regard the force of gravitation as the direct or indirect result of a consciousness or a will existing

somewhere." ["Outlines of Astronomy," 5th ed., p. 291.] And even if we cannot certainly identify force in all its forms with the direct energies of One Omnipresent and All-pervading Will, it is at least in the highest degree unphilosophical to assume the contrary—to speak or to think as if the forces of Nature were either independent of or even separate from the Creator's power.—ARGYLL *Reign of Law*, ch. 2, p. 73. (Burt.)

2372. NATURE PAINTED IN SHADOW—*Earth an Inferno or a Slaughter-house.*—The final result [of the doctrine of the struggle for life, as commonly stated] is a picture of Nature wholly painted in shadow—a picture so dark as to be a challenge to its Maker, an unanswered problem to philosophy, an abiding offense to the moral nature of man. The world has been held up to us as one great battle-field heaped with the slain, an inferno of infinite suffering, a slaughter-house resounding with the cries of a ceaseless agony.—DRUMMOND *Ascent of Man*, int., p. 19. (J. P., 1900.)

2373. NATURE, SECRETS OF, TO WHOM REVEALED—*Scientist Must Become as a Little Child.*—In the law-book of research on which natural science is based we read the same command as in the Scriptures: "Verily I say unto you, except ye become as little children ye shall not enter into the kingdom of heaven." Accordingly, we see the investigator everywhere striving to turn back to the standpoint of a child that forgets all sorrow whenever something that moves is given him to look at; it matters little whether a tin-plate set to spin, or a pussy in her play. Only, of course, between the manner in which the scientist marvels at these phenomena and that of a child there lies the chasm that separates the moral value of a human being ripened by experience from the innocence of a child.—DU BOIS-REYMOND *Tierische Bewegung (a Lecture).* (Translated for *Scientific Side-Lights.*)

2374. NATURE SEEN AT WORK—*Formation of Peat within a Human Lifetime.*—George, first Earl of Cromarty, seems . . . to have been a man of an eminently active and inquiring mind. He found leisure, in the course of a very busy life, to write several historical dissertations of great research. . . . His life was extended to extreme old age; and as his literary ardor remained undiminished till the last, some of his writings were produced at a period when most other men are sunk in the incurious indifferency and languor of old age. And among these later productions are his remarks on peat. He relates that when a very young man he had marked, in passing on a journey through the central Highlands of Ross-shire, a wood of very ancient trees, doddered and moss-grown, and evidently passing into a state of death through the last stages of decay. He had been led by business into the same district many years after, when in middle life, and found that the wood had entirely disappeared, and that the heathy hollow which it had covered was now occupied by a green, stagnant morass, unvaried in its tame and level extent by either bush or tree. In his old age he again visited the locality, and saw the green surface roughened with dingy-colored hollows, and several Highlanders engaged in it in cutting peat in a stratum several feet in depth. What he had once seen an aged forest had now become an extensive peat-moss.—MILLER *The Old Red Sandstone*, ch. 10, p. 173. (G. & L., 1851.)

2375. NATURE STIRS VARIED HUMAN EMOTIONS—The contemplation of the individual characteristics of the landscape, and of the conformation of the land in any definite region of the earth, gives rise to a different source of enjoyment. . . . At one time the heart is stirred by a sense of the grandeur of the face of Nature, by the strife of the elements, or, as in Northern Asia, by the aspect of the dreary barrenness of the far-stretching steppes; at another time softer emotions are excited by the contemplation of rich harvests wrested by the hand of man from the wild fertility of Nature, or by the sight of human habitations raised beside some wild and foaming torrent.—HUMBOLDT *Cosmos*, vol. i, int., p. 25. (H., 1897.)

2376. NATURE, STUDY OF, INTERESTS CHILDREN—*General Phenomena of Life Readily Learned—Lessons in Insects, Plants, or Shells.*—From pupils of ten or twelve years of age who have been properly instructed in the elements of biology, one may obtain a surprising accuracy in the answers given to both written and oral questions. The chief idea, however, to be borne in mind in teaching pupils of this early age is that the instruction must be limited to broad and general details, and, save in very exceptional cases, must not include attempts at specializing the science. The general phenomena of plant and animal life; the broad relations of the organic and inorganic worlds, and the general details of the structure and life history of the more familiar groups of animals and plants, present subjects which may be made, with sufficient means of illustration, to convey a great amount of solid information to the youngest pupil who is able to think for himself or herself. For example, I do not see that an intelligent teacher, with a good set of diagrams and a few specimens, should have the slightest difficulty in interesting a very youthful auditory in the structure and metamorphosis of insects, and in the general course of insect life. He would find in the details furnished by the common observation of his pupils a ready assent to and illustration of most of the facts he would

set before them; and he would send them back with renewed interest from his classroom to study the caterpillars in the garden, or the development of the silkworm's eggs, which formerly had been kept as mere playthings. A lecture on "Shells and their Inmates" would in like manner be readily illustrated; and with the aid of a few microscopes and some stagnant water the wonder and interest of the pupils might be excited over the description of lesser worlds than ours.—ANDREW WILSON *Biology in Education*, p. 17. (Hum., 1888.)

2377. NATURE SURPASSES HUMAN ESTIMATE—*A Hundred Feet of Iron Rods to Sound a Glacier.*—When I first began my investigations upon the glaciers, now more than twenty-five years ago, scarcely any measurements of their size or their motion had been made. One of my principal objects, therefore, was to ascertain the thickness of the mass of ice, generally supposed to be from eighty to a hundred feet, and even less. The first year I took with me a hundred feet of iron rods (no easy matter, where it had to be transported to the upper part of a glacier on men's backs), thinking to bore the glacier through and through. As well might I have tried to sound the ocean with a ten-fathom line. The following year I took two hundred feet of rods with me, and again I was foiled. Eventually I succeeded in carrying up a thousand feet of line, and satisfied myself, after many attempts, that this was about the average thickness of the glacier of the Aar, on which I was working.—AGASSIZ *Geological Sketches*, ser. i, ch. 8, p. 294. (H. M. & Co., 1896.)

2378. NATURE SURPASSES MAN—*Natural Surpasses Human Selection.*—As man can produce and certainly has produced a great result by his methodical and unconscious means of selection, what may not natural selection effect? Man can act only on external and visible characters; Nature, if I may be allowed to personify the natural preservation or survival of the fittest, cares nothing for appearances, except in so far as they are useful to any being. She can act on every internal organ, on every shade of constitutional difference, on the whole machinery of life. Man selects only for his own good; Nature only for that of the being which she tends. . . . Under Nature the slightest differences of structure or consititution may well turn the nicely balanced scale in the struggle for life, and so be preserved. How fleeting are the wishes and efforts of man! How short his time, and consequently how poor will be his results, compared with those accumulated by Nature during whole geological periods! Can we wonder, then, that Nature's productions should be far "truer" in character than man's productions; that they should be infinitely better adapted to the most complex conditions of life, and should plainly bear the stamp of far higher workmanship?—DARWIN *Origin of Species*, ch. 4, p. 76. (Burt.)

2379. NATURE'S BOATS HAVE WATER-TIGHT COMPARTMENTS—*Seeds That Bide Their Time.*—In the driftwood may be found dry fruits of the bladdernut, brown and light, an inch and a half in diameter. See how tough they are; they seem to be perfectly tight, and, even if one happens to have a hole punched in its side, there are probably two cells that are still tight, for there are three in all. Within are a few seeds, hard and smooth. Why are they so hard? Will it not be difficult for such seeds to get moist enough and soft enough to enable them to germinate? The hard coats enable the seeds to remain uninjured for a long time in the water, in case one or two cells of the papery pods are broken open; and after the tough pod has decayed and the seeds have sunken to the moist earth among the sticks and dead leaves, they can have all the time they need for the slow decay of their armor. Sooner or later a tiny plant is likely to appear and produce a beautiful bush. . . . But this is not all. Many of the dry nuts hang on all winter, or for a part of it, rattling in the wind, as tho loath to leave. Some of them are torn loose, and in winter there will be a better chance than at any other time for the wind to do the seeds a favor, especially when there is snow on the ground, for then they will bound along before the breeze till something interrupts them.—BEAL *Seed Dispersal*, ch. 4, p. 22. (G. & Co., 1898.)

2380. NATURE'S CARVING—*Rocks Cut and Polished by Glacier.*—This Grimsel is a weird region—a monument carved with hieroglyphics more ancient and more grand than those of Nineveh or the Nile. It is a world disinterred by the sun from a sepulcher of ice. All around are evidences of the existence and the might of the glaciers which once held possession of the place. All around the rocks are carved, and fluted, and polished, and scored. Here and there angular pieces of quartz, held fast by the ice, inserted their edges into the rocks and scratched them like diamonds, the scratches varying in depth and width according to the magnitude of the cutting stone. Larger masses, held similarly captive, scooped longitudinal depressions in the rocks over which they passed, while in many cases the polishing must have been effected by the ice itself. A raindrop will wear a stone away; much more would an ice surface, squeezed into perfect contact by enormous pressure, rub away the asperities of the rocks over which for ages it was forced to slide. The rocks thus polished by the ice itself are so exceedingly smooth and slippery that it is impossible to stand on them where their inclination is at all considerable.—TYNDALL *Hours of Exercise in the Alps*, ch. 7, p. 75. (A., 1898.)

2381. NATURE'S CONFORMITY TO LAW, THE FASCINATION OF—The greatest instance of what the human mind can effect by means of a well-recognized law of natural phenomena is that afforded by modern astronomy. The one simple law of gravitation regulates the motions of the heavenly bodies not only of our own planetary system, but also of the far more distant double stars, from which even the ray of light, the quickest of all messengers, needs years to reach our eye; and just on account of this simple conformity with law the motions of the bodies in question can be accurately predicted and determined both for the past and for future years and centuries to a fraction of a minute.

On this exact conformity with law depends also the certainty with which we know how to tame the impetuous force of steam and to make it the obedient servant of our wants. On this conformity depends, moreover, the intellectual fascination which chains the physicist to his subjects.—HELMHOLTZ *On the Conservation of Force, Popular Scientific Lectures*, p. 318. (Translated for *Scientific Side-Lights.)*

2382. NATURE'S FURNACES—*Crater of Volcano Filled with Boiling Lava.*—No one can look down on the mass of seething material in violent agitation within the fissures at the bottom of the crater of Stromboli, without being forcibly reminded of the appearances presented by liquids in a state of boiling or ebullition. The glowing material seems to be agitated by two kinds of movements, the one whirling or rotatory, the other vertical or up-and-down in its direction. The fluid mass in this way appears to be gradually impelled upwards till it approaches the lips of the aperture, when vast bubbles are formed upon its surface, and to the sudden bursting of these the phenomena of the eruption are due.—JUDD *Volcanoes*, ch. 2, p. 19. (A., 1899.)

2383. NATURE'S GREAT RESOLVENT—Except in very rare cases Nature never makes use of any other acid than carbonic acid to bring about decompositions, transformations, or new formations.—TIRKEL *Die Umwandlungsprocesse im Mineralreich*, p. 30. (Translated for *Scientific Side-Lights.)*

2384. NATURE'S MANY HUES FROM THREE PRIMARY COLORS—Young, Helmholtz, and Maxwell reduce all differences of hue to combinations in different proportions of three primary colors. It is demonstrable by experiment that from the red, green, and violet all the other colors of the spectrum may be obtained.—TYNDALL *Light*, lect. 1, p. 40. (A., 1898.)

2385. NATURE'S MASTERPIECES OF LIFE—*Inheritance from Ancient Ages.*—Above all other [forms], we should protect and hold sacred those types, Nature's masterpieces, which are first singled out for destruction on account of their size, or splendor, or rarity, and that false detestable glory which is accorded to their most successful slayers. In ancient times the spirit of life shone brightest in these; and when others that shared the earth with them were taken by death they were left, being more worthy of perpetuation. Like immortal flowers they have drifted down to us on the ocean of time, and their strangeness and beauty bring to our imaginations a dream and a picture of that unknown world, immeasurably far removed, where man was not: and when they perish, something of gladness goes out from Nature, and the sunshine loses something of its brightness.—HUDSON *Naturalist in La Plata*, ch. 1, p. 29. (C. & H., 1895.)

2386. NATURE'S NON-CONDUCTING MEDIUM—*Experiment with Molten Iron.*—Mr. Nasmyth, the inventor of the steam-hammer, has lately illustrated, by a very striking experiment, the non-conductibility of a thin layer of dry sand and clay. Into a caldron of iron one-fourth of an inch thick, lined with sand and clay five-eighths of an inch thick, he poured eight tons of melted iron at a white heat. After the fused metal had been twenty minutes in the caldron the palm of the hand could be applied to the outside without inconvenience, and after forty minutes there was not heat enough to singe writing-paper. This fact may help us to explain how strata in contact with dikes, or beds of fused matter, have sometimes escaped without perceptible alteration by heat.—LYELL *Geology*, ch. 25, p. 413. (A., 1854.)

2387. NATURE'S PARADOX—*Water an Unyielding Substance—Bacon First Proved It Incompressible—"The Florentine Experiment" a Later Copy.*—Water yields so freely to the hand that you might suppose it to be easily squeezed into a smaller space. That this is not the case was proved more than two hundred and sixty years ago by Lord Bacon. He filled a hollow globe of lead with the liquid, and, soldering up the aperture, tried to flatten the globe by the blows of a heavy hammer. He continued hammering "till the water, impatient of further pressure, exuded through the solid lead like a fine dew." Water was thus proved to offer an immense resistance to compression. Nearly fifty years afterwards, a similar experiment, with the same result, was made by the members of the Academy Del Cimento in Florence. They, however, used a globe of silver instead of a globe of lead. This experiment is everywhere known as "the Florentine experiment"; but Ellis and Spedding, the eminent biographers of Bacon, have clearly shown that it ought to be called "the Baconian experiment."—TYNDALL *New Fragments*, p. 343. (A., 1897.)

2388. NATURE'S PICTURE-BOOK—*Wonders of Geology.*—We may turn over these wonderful leaves [strata] one after

one, like the leaves of a herbarium, and find the pictorial records of a former creation in every page. Scallops, and gryphites, and ammonites, of almost every variety peculiar to the formation, and at least some eight or ten varieties of belemnite; twigs of wood, leaves of plants, cones of an extinct species of pine, bits of charcoal, and the scales of fishes; and, as if to render their pictorial appearance more striking, tho the leaves of this interesting volume are of a deep black, most of the impressions are of a chalky whiteness. I was lost in admiration and astonishment, and found my very imagination paralyzed by an assemblage of wonders that seemed to outrival, in the fantastic and the extravagant, even its wildest conceptions. I passed on from ledge to ledge, like the traveler of the tale through the city of statues.—MILLER *The Old Red Sandstone*, ch. 1, p. 10. (G. & L., 1851.)

2389. NATURE'S PREMIUM ON GOOD MOTHERS—*The Survival of the Fittest Forces Altruism upon the World.*—A mother who did not care for her children would have feeble and sickly children. Their children's children would be feeble and sickly children. And the day of reckoning would come when they would be driven off the field by a hardier, that is a better-mothered, race. Hence the premium of Nature upon better mothers. Hence the elimination of all the reproductive failures, of all the mothers who fell short of completing the process to the last detail. And hence, by the law of the survival of the fittest, altruism, which at this stage means good-motherism, is forced upon the world.—DRUMMOND *Ascent of Man*, ch. 7, p. 265. (J. P., 1900.)

2390. NATURE'S PURIFIER—*Sand the Great Filter.*—So convinced was Koch of the efficiency of sand-filtration as protection against disease-producing germs that he advocated an adaptation of this plan in places where it was found that a well yielded infected water. Such pollution in a well may be due to various causes; surface-polluted water oozing into the well is probably the commonest, but decaying animal or vegetable matter might also raise the number of micro-organisms present almost indefinitely. Koch's proposal for such a polluted well was to fill it up with gravel to its highest water-level, and above that, up to the surface of the ground, with fine sand. Before the well is filled up in this manner it must, of course, be fitted with a pipe passing to the bottom and connected with a pump. This simple procedure of filling up a well with gravel and sand interposes an effectual filter-bed between the subsoil water and any foul surface water percolating downwards. Such an arrangement yields as good, if not better, results than an ordinary filter-bed, on account of there being practically no disturbance of the bed nor injury done to it by frost.—NEWMAN *Bacteria*, ch. 2, p. 77. (G. P. P., 1899.)

2391. NATURE'S STEAM-JETS—*Vast Masses of Rock Ejected from Volcano.*—A volcano is essentially a steam-jet, and the steam almost certainly is derived from water buried in the rocks at the time of their formation. The quantity of matter extruded by a volcano is very great. We get an inadequate sense of its mass from the cones which are accumulated about the point of ejection. Thus in the case of Etna, a volcano, vast tho it is, of the second order of magnitude in terrestrial cones, we find in and around the elevation a mass of ejected rocky material which amounts in volume to somewhere near one thousand cubic miles; yet this prodigious mass of matter is only a small part of that which has been ejected from the vent.—SHALER *Nature and Man in America*, ch. 2, p. 62. (S., 1899.)

2392. NAVIGATION, ANCIENT—*The Merchant Princes of Other Days—Phenicians and Sidonians.*—The [Phenicians] . . . widened the domain of knowledge in several directions by independent inventions of their own. A state of industrial prosperity, based on an extensive maritime commerce, and on the enterprise manifested at Sidon in the manufacture of white and colored glasswares, tissues, and purple dyes, necessarily led to advancement in mathematical and chemical knowledge, and more particularly in the technical arts. "The Sidonians," writes Strabo, "are described as industrious inquirers in astronomy, as well as in the science of numbers, to which they have been led by their skill in arithmetical calculation, and in navigating their vessels by night, both of which are indispensable to commerce and maritime intercourse."—HUMBOLDT *Cosmos*, vol. ii, pt. ii, p. 129. (H., 1897.)

2393. NAVIGATION BY SPIDERS—*The Raft of the Hunting-spider.*—The following is quoted from Büchner:

"Less idyllic than the water-spider is our native hunting-spider, *Dolomedes fimbriata*, which belongs to those species which spin no web, but hunt their victims like animals of prey. As the *Argyroneta* is the discoverer of the diving-bell, so may this be regarded as the discoverer or first builder of a floating raft. It is not content with hunting insects on land, but follows them on the water, on the surface of which it runs about with ease. It, however, needs a place to rest on, and makes it by rolling together dry leaves and such like bodies, binding them into a firm whole with its silken threads. On this raftlike vessel it floats at the mercy of wind and waves; and if an unlucky water-insect comes for an instant to the surface of the water to breathe, the spider darts at it with lightning speed, and carries it back to its raft to devour at its ease.—ROMANES *Animal Intelligence*, ch. 6, p. 213. (A., 1899.)

2394. NAVIGATION GUIDED BY THE STARS—*Mariners of Tyre and Sidon*—

The Cynosure.—At the epoch when the maritime power of the Phenicians was at its apogee, about 3,000 years ago, or twelve centuries before our era, it was the star β of the Little Bear . . . which was the nearest bright star to the pole, and the skilful navigators of Tyre and Sidon (O purpled kings of former times! what remains of your pride?) had recognized the seven stars of the Little Bear, which they named the Tail of the Dog, "Cynosura"; they guided themselves by the pivot of the diurnal motion, and during several centuries they surpassed in precision all the mariners of the Mediterranean. The dog had given place to a bear, doubtless on account of the resemblance of the configuration of these seven stars to the seven of the Great Bear, but the tail remains long and curled up, in spite of the nature of the new animal.

Thus the stars of the north at first served as points of reference for the first men who dared to venture on the seas. But they served at the same time as guides on the mainland for the nomadic tribes who carried their tents from country to country. In the midst of savage nature, the first warriors themselves had nothing but the Little Bear to guide their steps.—FLAMMARION *Popular Astronomy,* bk. vi, ch. 1, p. 556. (A.)

2395. NAVY, BRITISH, STOPPAGE OF GROG IN—*Reduction of Crimes of Violence—Dangers of Incipient Intoxication.*—It would seem that in whatever way the exertion of volitional power is related to the condition of the brain, this exertion is interfered with by the use of intoxicating agents, before there is any serious perversion of the automatic [muscular] activity. . . . It is in this primary stage of alcoholic excitement that a large number of "crimes of violence," as well as of minor offenses, are committed, as is shown by the remarkable reduction in these which took place in the navy immediately that the "evening grog" was stopped. The following very characteristic instance of this kind was related to the Admiralty Committee on whose recommendation this change was made:

"I had a marine," said Captain Drew, "who was constantly complained against for quarreling and fighting and disobedience to the orders of his sergeant. At length I began with flogging him, and told him that I would increase his punishment every time that I had a complaint against him. This I had to do twice; and as the man was constantly excited it appeared to me that the man's reason must be affected. I therefore applied to the surgeon and asked him to examine the man to see whether he was not a fit subject for invaliding, but the surgeon reported that he was as fine and healthy a young man as there was in the ship. I then did not think myself justified in flogging him again, but took upon myself to do an illegal act with a good intention, and when we came into harbor (in the West Indies) I hired a cell in the gaol and kept him there three days upon bread and water. When the man came out of gaol I told him that whenever I had a complaint against him, as sure as we came into harbor I would send him to gaol; but that if he would choose to alter his conduct I would start afresh with him and forget everything that had happened. He said that he was very much obliged to me, and he came to me the next day and asked me if I would stop his allowance of grog and let him be paid for it. I did so, and never had another complaint against the man while I was in the ship."—CARPENTER *Mental Physiology,* ch. 17, p. 649. (A., 1900.)

2396. NEARNESS IN TIME ASCRIBED TO GREAT PUBLIC EVENTS—*Vividness Suggests Proximity.*—The most striking examples of the illusory effect of mere vividness, involving a complete detachment of the event from the prominent landmarks of the past, are afforded by public events which lie outside the narrower circle of our personal life, and which do not in the natural course of things become linked to any definitely localized points in the field of memory. These events may be very stirring and engrossing for the time, but in many cases they pass out of the mind just as suddenly as they entered it. We have no occasion to revert to them, and if by chance we are afterwards reminded of them they are pretty certain to look too near, just because the fact of their having greatly interested us has served to render their images particularly vivid.—SULLY *Illusions,* ch. 10, p. 258. (A., 1897.)

2397. NEBULÆ NOT WHOLLY COMPOSED OF STARS—*Gaseous Constituents—Perhaps Systems in Process of Formation.*—In many nebulæ small stars can be seen. . . . More stars are continually being discovered in them, the better are the telescopes used in their analysis. Thus, before the discovery of spectrum analysis, Sir W. Herschel's former view might be regarded as the most probable, that that which we see to be nebulæ are only heaps of very fine stars, of other "Milky Ways." Now, however, spectrum analysis has shown a gas spectrum in many nebulæ which contain stars.—HELMHOLTZ *Popular Lectures,* lect. 4, p. 187. (L. G. & Co., 1898.)

2398. NECESSITY OF CONFLICT AND WAR—*Combativeness Inherent in Man.*—In many respects man is the most ruthlessly ferocious of beasts. As with all gregarious animals, "two souls," as Faust says, "dwell within his breast," the one of sociability and helpfulness, the other of jealousy and antagonism to his mates. Tho in a general way he cannot live without them, yet, as regards certain individuals, it often falls out that he cannot live with them either. Constrained to be a member of a tribe, he still has a right to decide, as far as in him lies, of which other members the

tribe shall consist. Killing off a few obnoxious ones may often better the chances of those that remain. And killing off a neighboring tribe from whom no good thing comes, but only competition, may materially better the lot of the whole tribe. Hence the gory cradle, the *bellum omnium contra omnes*, in which our race was reared; hence the fickleness of human ties, the ease with which the foe of yesterday becomes the ally of to-day, the friend of to-day the enemy of to-morrow; hence the fact that we, the lineal representatives of the successful enactors of one scene of slaughter after another, must, whatever more pacific virtues we may also possess, still carry about with us, ready at any moment to burst into flame, the smoldering and sinister traits of character by means of which they lived through so many massacres, harming others, but themselves unharmed.—JAMES *Psychology*, vol. ii, ch. 24, p. 409. (H. H. & Co., 1899.)

2399. NECESSITY OF PAIN—*Its Chief Use Not for the Individual, but for the Race.*—We must, therefore, accept pain as a fact existing by a deep necessity, having its root in the essential order of the world. If we are to understand it, we must learn to look on it with different eyes. And does not a different thought suggest itself even while we recognize that the others fail? For if the reason and the end of pain lie beyond the results that have been mentioned, then they lie beyond the individual. Pain, if it exist for any purpose, and have any end or use—and of this what sufferer can endure to doubt?—must have some purpose which extends beyond the interest of the person who is called upon to bear it. . . .

These uses of pain, which concern the one who suffers only [as leading to avoidance of danger, etc.], must fail and be found insufficient. . . . But when we extend our thought, and recognize not only that there are, in pain, ends unseen by us, but that these ends may not be confined within the circle of our own interests, surely a light begins to glimmer through the darkness. While we look only at that which directly concerns the individual who suffers, no real explanation of suffering, no satisfaction that truly satisfies, can be found. But if we may look beyond and see in our own sufferings, and in the sufferings of all, something in which mankind also has a stake, then they are brought into a region in which the heart can deal with them and find them good. And if the heart, the reason also. For here it is the soul that is the judge; and if the heart is satisfied, the reason also is content.—HINTON *The Mystery of Pain*, p. 19. (Hum., 1893.)

2400. NEEDLE, MAGNETIC, ANCIENT KNOWLEDGE OF—*Early Chinese Record of "Needle Pointing South"—Polarity a Puzzle.*—No definite statement, however, is found until the end of the eleventh century is reached, and then in a work entitled "Mung-Khi-pithan" we meet the following extraordinary passage:

"The soothsayers rub a needle with the magnet stone so that it may mark the south; however, it declines constantly a little to the east. It does not indicate the south exactly. When this needle floats on the water it is much agitated. If the finger-nails touch the upper edge of the basin in which it floats they agitate it strongly, only it continues to slide and falls easily. It is better, in order to show its virtues in the best way, to suspend it as follows: Take a single filament from a piece of new cotton and attach it exactly to the middle of the needle by a bit of wax as large as a mustard-seed. Hang it up in a place where there is no wind. Then the needle constantly shows the south; but among such needles there are some which, being rubbed, indicate the north. Our soothsayers have some which show south and some which show north. Of this property of the magnet to indicate the south, like that of the cypress to show the west, no one can tell the origin."—BENJAMIN *Intellectual Rise in Electricity*, ch. 3, p. 75. (J. W., 1898.)

2401. ——— ——— *Occident Indebted to Orient.*—While the gradually developed knowledge of relations in space incited men to think of shorter sea routes, the means for perfecting practical navigation were likewise gradually increased by the application of mathematics and astronomy, the invention of new instruments of measurement, and by a more skilful employment of magnetic forces. It is extremely probable that Europe owes the knowledge of the northern and southern directing powers of the magnetic needle—the use of the mariner's compass—to the Arabs, and that these people were in turn indebted for it to the Chinese. . . . In the third century of our era, under the dynasty of Han, there is a description given in Hiutschin's dictionary Schuewen of the manner in which the property of pointing with one end toward the south may be imparted to an iron rod by a series of methodical blows. Owing to the ordinary southern direction of navigation at that period, the south pointing of the magnet is always the one especially mentioned. A century later, under the dynasty of Tsin, Chinese ships employed the magnet to guide their course safely across the open sea, and it was by means of these vessels that the knowledge of the compass was carried to India, and from thence to the eastern coasts of Africa.—HUMBOLDT *Cosmos*, vol. ii, pt. ii, p. 253. (H., 1897.)

2402. NEGATION OF FIXED MODES GIVES MAN PREEMINENCE—*New Principles for New Cases.*—In them [the lower animals] fixed habit is the essential and characteristic law of nervous action. The brain grows to the exact modes in which it has been exercised, and the inheritance of these modes—then called instincts—would

have in it nothing surprising. But in man the negation of all fixed modes is the essential characteristic. He owes his whole preeminence as a reasoner, his whole human quality of intellect, we may say, to the facility with which a given mode of thought in him may suddenly be broken up into elements which recombine anew. Only at the price of inheriting no settled instinctive tendencies is he able to settle every novel case by the fresh discovery by his reason of novel principles.—JAMES *Psychology*, vol. ii, ch. 22, p. 368. (H. H. & Co., 1899.)

2403. NEGLECT, DETERIORATION THE PENALTY OF—*Effort Needed for Excellence (Heb. ii, 3).*—If we neglect a garden plant, then a natural principle of deterioration comes in and changes it into a worse plant. And if we neglect a bird, by the same imperious law it will be gradually changed into an uglier bird. Or if we neglect almost any of the domestic animals, they will rapidly revert to wild and worthless forms again.

Now the same thing exactly would happen in the case of you or me. Why should man be an exception to any of the laws of Nature? Nature knows him simply as an animal — subkingdom *Vertebrata*, class *Mammalia*, order *Bimana*. And the law of reversion to type runs through all creation If a man neglect himself for a few years he will change into a worse man and a lower man. If it is his body that he neglects, he will deteriorate into a wild and bestial savage, like the dehumanized men who are discovered sometimes upon desert islands. If it is his mind it will degenerate into imbecility and madness—solitary confinement has the power to unmake men's minds and leave them idiots. If he neglect his conscience, it will run off into lawlessness and vice. Or, lastly, if it is his soul, it must inevitably atrophy, drop off in ruin and decay.—DRUMMOND *Natural Law in the Spiritual World*, essay 2, p. 88. (H. Al.)

2404. NEGLECT OF SANITATION INVITES ZYMOTIC DISEASE—*Oppression Opens the Way for Pestilence — Human Brotherhood May Involve the Most Discreet with the Most Degraded.*—We learn from this marvelous discovery [of the destruction of disease-germs by the leucocytes or white blood-corpuscles] that so long as we live simply and naturally, and obey the well-known laws of sanitation, so as to secure a healthy condition of the body, the more dreaded zymotic diseases will be powerless against us. But if we neglect these laws of health, or allow of conditions which compel large bodies of our fellow men to neglect them, these disease-germs will be present in such quantities in the air and the water around us that even those who personally live comparatively wholesome lives will not always escape them.—WALLACE *The Wonderful Century*, ch. 14, p. 146. (D. M. & Co., 1899.)

2405. NEIGHBOR, ANCIENT IDEA OF—*Moral Obligation Limited to Tribe.*—It must be clearly understood also that the Old-World rules of moral conduct were not the same towards all men. A man knew his duty to his neighbor, but all men were not his neighbors. This is very clearly seen in the history of men's ideas of manslaughter and theft. . . . The old state of things is well illustrated in the Latin word *hostis*, which, meaning originally "stranger," passed quite naturally into the sense of "enemy." Not only is slaying an enemy in open war looked on as righteous, but ancient law goes on the doctrine that slaying one's own tribesman and slaying a foreigner are crimes of quite different order, while killing a slave is but a destruction of property. Nor even now does the colonist practically admit that killing a brown or black man is an act of quite the same nature as killing a white countryman. Yet the idea of the sacredness of human life is ever spreading more widely in the world, as a principle applying to mankind at large.

The history of the notion of theft and plunder follows partly the same lines. In the lower civilization the law, "Thou shalt not steal," is not unknown, but it applies to tribesmen and friends, not to strangers and enemies.—TYLOR *Anthropology*, ch. 16, p. 411. (A., 1899.)

2406. NERVE-FORCE CAPABLE OF EXHAUSTION—*Sensations More Vivid after Remission—Maximum of Power Follows Repose.*—The nerve-pores and corpuscles, on being stimulated, undergo a process of change, whereby their power is gradually exhausted, in consequence of which they need remission and repose. Hence, the first moments of a stimulus are always the freshest, and give birth to the most vivid degrees of consciousness. This is the condition more especially requisite for maintaining a state of pleasurable sensibility. The nervous system should be duly refreshed or invigorated by nourishment and repose, and never pushed in any part to the extreme limits of exhaustion. The same condition applies to our power of active energy in every department, whether intellectual, voluntary, or emotional. Power is at the maximum, under a fresh start of renovated nerves, and fails as we approach the point of exhaustion. There are certain exceptional manifestations, as in the common experience of "growing warm" to one's work; the maximum of energy usually shows itself some time after commencing, an effect due entirely to the increased supply of blood following on a certain amount of exercise.—BAIN *Mind and Body*, ch. 4, p. 12. (Hum., 1880.)

2407. NERVES COMMUNICATE THROUGH CENTERS—*Illustration of Mail Sent through Distributing Office.*—The plan of communicating from one part of the body to another—as from the skin of the hand

to the muscles of the arm—is not by a direct route from the one spot to the other, but by a nervous center. Every nerve-fiber rising from the surface of the body, or from the eye or the ear, goes first of all to the spinal cord or to some part of the brain; and any influence exerted on the movements by stimulating these fibers passes out from some nervous center. As in the circulation of letters by post, there is no direct comunication between one street and another, but every letter passes first to the central office, so the transmission of influence from one member of the body to another is exclusively through a center, or (with a few exceptions) through some part of the nervous substance contained in the head and backbone. Every communication is centralized, and in consequence there is not only great economy of the conducting machinery, but also an avoidance of conflicting messages.—Bain *Mind and Body*, ch. 3, p. 8. (Hum., 1880.)

2408. NERVES, SPECIFIC ACTION OF—*Senses Never Confused—Eye Tells Only of Light, Ear of Sound.*—Every nerve of sense has a peculiar kind of sensation. We know that each nerve can be rendered active by a vast number of exciting agents, and that the same agent may affect different organs of sense; but no matter how it may be brought about, we never receive from nerves of sight any other sensation than that of light, nor from the nerves of the ear any other sensation than that of sound. In short, we derive from each individual nerve of sense that sensation only that corresponds to its specific action. The most marked differences in the qualities of sensation, that is to say, those between sensations from different senses, are consequently in no way dependent on the nature of the exciting agent, but only on the nerve apparatus that is operated upon.—Helmholtz *Aim and Progress of Physical Science (Popular Lectures on Scientific Subjects*, p. 391). (Translated for *Scientific Side-Lights.)*

2409. NERVES THE INTERPRETERS OF THE WORLD TO THE MIND—Between the mind of man and the outer world are interposed the nerves of the human body, which translate, or enable the mind to translate, the impressions of that world into facts of consciousness and thought.—Tyndall *Fragments of Science*, ch. 2, p. 28. (A., 1897.)

2410. NESTLINGS NOT TIMID IF GENTLY APPROACHED—*No Instinctive Fear of Man.*—To return to what may be seen in nestling birds. When very young, and before their education has well begun, if quietly approached and touched, they open their bills and take food as readily from a man as from the parent bird. But if while being thus fed the parent returns and emits the warning note they instantly cease their hunger cries, close their gaping mouths, and crouch down frightened in the nest.—Hudson *Naturalist in La Plata*, ch. 5, p. 89. (C. & H., 1895.)

2411. NESTS REBUILT ON SAME SITES—*Migratory Birds Return to Early Homes.*—For many years in succession a pair of blue titmice built their nest in an earthenware bottle placed in the branches of a tree in a garden at Oxbridge, near Stockton-on-Tees, and even where the surface of the country has undergone a complete change some species will continue breeding on the beloved spot. In America orioles and vireos appear to return to the same tree, or even to affix their nest to the same branch, for many successive years; and in like manner Allen has noticed how the wren, the pewee, and the robin repeatedly occupy the same nesting sites.—Brown *Nature-Studies*, p. 16. (Hum., 1888.)

2412. NET, THE, COEVAL WITH HISTORY—*Egyptian Monuments Show Its Skilful Use.*—The net is one of the things known to almost all men so far as history can tell. The native Australians net game like ancient Assyrians or English poachers, and are not less skilled in netting wild fowl. To see this art at its height we may look at the pictures of fowling-scenes on the monuments of ancient Egypt, which show the great clap-nets taking geese by scores; even the souls of the dead are depicted rejoicing in this favorite sport in the world beyond the tomb.—Tylor *Anthropology*, ch. 9, p. 212. (A., 1899.)

2413. NEWS "AHEAD OF TIME"—*Electricity Outtravels the Sun.*—We are now able to receive accounts of great events almost while they are happening on the other side of the globe; and, owing to difference of longitude, we sometimes can hear of an event apparently before it has happened. If some great official were to die at Calcutta at sunset, we should receive the news soon after noon on the same day.—Wallace *The Wonderful Century*, ch. 3, p. 21. (D. M. & Co., 1899.)

2414. NEWS BY TELEPHONE—*Printing of Extras Dispensed with.*—The telephone is actually in operation at Budapest in the form of a telephonic newspaper. At certain fixed hours throughout the day a good reader is employed to send definite classes of news along the wires which are laid to subscribers' houses and offices, so that each person is able to hear the particular items he desires, without the delay of its being printed and circulated in successive editions of a newspaper. It is stated that the news is supplied to subscribers in this way at little more than the cost of a daily newspaper, and that it is a complete success.—Wallace *The Wonderful Century*, ch. 3, p. 23. (D. M. & Co., 1899.)

2415. NEWTON SECURES A FILM THAT IS VARIABLE AND MEASURABLE

—*Newton's Rings—Illustrate Interference of Light-waves.*—Newton . . . determined by accurate measurements the relation of the thickness of the film to the color of displays. [See COLORS OF THIN PLATES; PLATES.] In doing this his first care was to obtain a film of variable and calculable depth. On a plano-convex glass lens . . . of very feeble curvature he laid a plate of glass . . . with a plane surface, thus obtaining a film of air of gradually increasing depth from the point of contact . . . outwards. On looking at the film in monochromatic light he saw, with the delight attendant on fulfilled prevision, surrounding the place of contact a series of bright rings separated from each other by dark ones and becoming more closely packed together as the distance from the point of contact augmented. . . . When he employed red light, his rings had certain diameters; when he employed blue light, the diameters were less. In general terms, the more refrangible the light the smaller were the rings. Causing his glasses to pass through the spectrum from red to blue, the rings gradually contracted; when the passage was from blue to red, the rings expanded. This is a beautiful experiment, and appears to have given Newton the most lively satisfaction. When white light fell upon the glasses, inasmuch as the colors were not superposed, a series of *iris-colored circles* was obtained. . . . In monochromatic light the rings run closer and closer together as they recede from the center. This is due to the fact that at a distance the film of air thickens more rapidly than near the center. When white light is employed this closing up of the rings causes the various colors to be superposed, so that after a certain thickness they are blended together to white light, the rings then ceasing altogether.—TYNDALL *Lectures on Light*, lect. 2, p. 72. (A., 1898.)

2416. NICHE OF SCIENCE UNFILLED—*Why Not a Shrine of Deity (Ps. xc, 2).*—" Does the vital," he [Professor Knight] asks, " proceed by a still remoter development from the non-vital? Or was it created by a fiat of volition? Or "—and here he emphasizes his question—" *has it always existed in some form or other as an eternal constituent of the universe?* I do not see," he replies, " how we can escape from the last alternative." With the whole force of my conviction I say, Nor do I, tho our modes of regarding the " eternal constituent " may not be the same.—TYNDALL *Fragments of Science*, vol. ii, ch. 15, p. 376. (A., 1900.)

2417. NIGHT, ADAPTATION TO—*Colors of Nocturnal Animals.*—Nocturnal animals supply another illustration of the same rule [of protective coloration] in the dusky colors of mice, rats, bats, and moles, and in the soft-mottled plumage of owls and goat-suckers which, while almost equally inconspicuous in the twilight, are such as to favor their concealment in the daytime.—WALLACE *Darwinism*, ch. 8, p. 131. (Hum.)

2418. NIGHT AND DAY, MYTHS WOVEN AROUND—*Story of Little Red Riding-hood an Ancient Relic.*—Of all the nature-myths of the world few are so widely spread as those on this theme of night and day, where with mythic truth the devoured victims were afterwards disgorged or set free. The Zulu story-tellers describe the maw of the monster as a country where there are hills and houses and cattle and people living, and, when the monster is cut open, all the creatures come out from the darkness; with a neat touch of nature, which shows that the story-teller is thinking of the dawn, the cock comes out first, crying " *kukuluku!* I see the world!" Our English version of the old myth is the nursery tale of Little Red Riding-hood, but it is spoilt by leaving out the proper end (which German nurses have kept up with better memory), that when the hunter ripped up the sleeping wolf out came the little damsel in her red satin cloak, safe and sound.—TYLOR *Anthropology*, ch. 15, p. 392. (A., 1899.)

2419. NIGHT A TIME OF ANXIETY TO PRIMEVAL MAN—*What if Day Should Return No More?—Joyous Welcome to the Rising Sun.*—The ancient poems of India have even preserved for us the last echoes of the fears of primeval man at the approach of night. The sun, the good sun, has completely disappeared in the west: is it certain that he will return to-morrow morning in the east? If he should return no more! no more light, no more heat; the frozen night, gloomy night, covers the world! How shall we recover the lost fire? How replace the beneficent sun and his celestial light? The stars from the height of the heavens shed their melancholy light; the moon pours out in the vacuities of the atmosphere that rosy, silvery light which diffuses such a charm upon the sleep of Nature; but this is not the sun, this is not the day. . . . Ah, see the dawn, which brightens slowly! Behold the light, behold the day! Sun! King of the heavens, be blessed! Oh! never forget to return!—FLAMMARION *Popular Astronomy*, bk. i, ch. 2, p. 13. (A.)

2420. NIGHT IN TROPICAL FOREST—*Discordant Cries—Wide-spread Conflict among Animals.*—After eleven o'clock, such a noise began in the contiguous forest that for the remainder of the night all sleep was impossible. The wild cries of animals rung through the woods. Among the many voices which resounded together, the Indians could only recognize those which, after short pauses, were heard singly. There was the monotonous, plaintive cry of the *Aluates* (howling monkeys), the whining, flutelike notes of the small sapajous, the grunting murmur of the striped nocturnal ape

(Nyctipithecus trivirgatus, . . .), the fitful roar of the great tiger (the cougar or maneless American lion), the peccary, the sloth, and a host of parrots, parraquas *(Ortalides)*, and other pheasant-like birds. Whenever the tigers approached the edge of the forest, our dog, who before had barked incessantly, came howling to seek protection under the hammocks. Sometimes the cry of the tiger resounded from the branches of a tree, and was then always accompanied by the plaintive piping tones of the apes, who were endeavoring to escape from the unwonted pursuit.

If one asks the Indians why such a continuous noise is heard on certain nights, they answer, with a smile, that "the animals are rejoicing in the beautiful moonlight and celebrating the return of the full moon." To me the scene appeared rather to be owing to an accidental, long-continued, and gradually increasing conflict among the animals. Thus, for instance, the jaguar will pursue the peccaries and the tapirs, which, densely crowded together, burst through the barrier of treelike shrubs which opposes their flight. Terrified at the confusion, the monkeys on the tops of the trees join their cries with those of the larger animals. This arouses the tribes of birds who build their nests in communities, and suddenly the whole animal world is in a state of commotion. Further experience taught us that it was by no means always the festival of moonlight that disturbed the stillness of the forest; for we observed that the voices were loudest during violent storms of rain, or when the thunder echoed and the lightning flashed through the depths of the woods.—HUMBOLDT *Views of Nature*, p. 199. (Bell, 1896.)

2421. NIGHT, NEED OF — *Celestial Splendors Revealed Only in Darkness—Astronomers on Worlds Lighted by Double Suns Journeying Afar to Obtain More Night—The Starry Heavens Deemed More Magnificent if Seldom Seen.*—Very singular also must be the aspect of the different planets which are variously illuminated by the orange and blue suns. Instead of shining as the planets of the solar system shine, with a nearly constant color—their own inherent color—the planets of a double-sun system must vary in aspect according to their positions with respect to the two suns which illuminate them.

There is but one circumstance in which the celestial scenery presented to ourselves surpasses that which must be exhibited to the inhabitants of such a world as we have been considering. The glories of the star-depths are seldom seen from such a world; night is the exception, and often for many weeks in succession there can be no real night, but an alternation of colored days scarcely separated by brief periods of colored twilight when the orange and blue suns are but slightly below opposite horizons. It may be that on this very account night, being rare, is more valued, and the significance of the night-sky more imposing than with ourselves. But it is a strange thought that the astronomers of those distant worlds—for such worlds we must believe there are—may, in their zeal for science, undertake long journeys to obtain more night during which they may study the wonders of the starlit heavens.—PROCTOR *Expanse of Heaven*, p. 233. (L. G. & Co., 1897.)

2422. NIGHT VOCAL WITH BIRDS OF PASSAGE—*Aerial Armies Crossing Land and Sea—Nocturnal Migration of Birds.*—But marked tho the migratory season is in England, we see less of it than do our Continental neighbors, especially those who inhabit countries on the line of the great spring and autumn flights to and from the north of Europe. Morning and evening, and, indeed, all day long, the Heligolander may watch from his red rock in the North Sea the wild ducks winging their way in long "badelynges," led by an elderly drake performing the part of a personal conductor, and quaking with joy at the sight of the river-mouth which they had in memory ever since they left the Lapland lakes or the Siberian tundra. Every night—unless the sky is clear and the moon enables the migrants to continue their flight without trepidation—there is a Babel-like clamor overhead, and the lighthouse lantern is surrounded by myriads of larks, snipes, and plover, which have beat against it on their dreary night-journey from the north, or by the mysterious-mannered knots returning from their philanderings in some nameless land around the pole. In one night sometimes as many as 15,000 larks have been caught, and tho the resident birds of Heligoland do not exceed a dozen species, it is, perhaps, no exaggeration to say that the visitors exceed those of the greatest country in Europe.—BROWN *Nature-Studies*, p. 13. (Hum., 1888.)

2423. NIGHTMARE OF ANTHROPOMORPHISM—*Conception of Supreme Intelligence Treated as an Absurdity.*—Another nightmare meets us here—another suggestion of hopeless doubt respecting the very possibility of knowledge touching questions such as these. . . . The suggestion, in short, is not merely that the answer to these questions is inaccessible, but that there is no answer at all. The objection is a fundamental one, and is summed up in the epithet applied to all such inquiries—that they are "anthropomorphic." They assume authorship in a personal sense, which is a purely human idea; they assume causation, which is another human idea, and they assume the use of means for the attainment of ends, which also is purely human. It is considered by some persons as a thing in itself absurd that we should thus shape our conceptions of the ruling Power in Nature, or of a Divine Being, upon the conscious knowledge we have of our

own nature and attributes. Anthropomorphism is the phrase employed to condemn this method of conception—an opprobrious epithet, as it were, which is attached to every endeavor to bring the higher attributes of the human mind into any recognizable relation with the supreme agencies in Nature.—ARGYLL *Unity of Nature*, ch. 5, p. 99. (Burt.)

2424. NITROGEN, LOSS OF, AS AFFECTED BY ALCOHOL — *Recent Experiments in Germany.*—Miura justly drew the conclusion that in his experiments alcohol had not only proved itself as not albumin-saving, but as a protoplasm poison.

Finally, we have also the most recent experiments by Schmidt and Schöneseiffen, performed with the greatest precautions under Rosemann at Greifswald. Schmidt added alcohol to the food by which he had obtained his nitrogenous equilibrium in such quantity that if the number of calories had been furnished by carbohydrates they certainly would have produced a considerable storing up of nitrogen, whereas the addition of alcohol produced a considerable loss of body-albumin. [Schmidt, "Inaugural Dissertation," Greifswald, 1898.]

Schöneseiffen adopted another method in his experiments. At first an insufficient amount of food was given, so that daily there was a slight loss of nitrogen. After this, alcohol was given in such a quantity that the number of calories were not only compensated, but supplied in more than double the number required. This would have led to a storing up of nitrogen if the calories had been supplied by carbohydrates. But the experiment showed that not even the loss of nitrogen was stopped by alcohol. Hence, here again, alcohol has not manifested any albumin-saving properties. [Schöneseiffen, *idem*, 1899.]

If we sum up the results of these experiments we certainly must agree with Rosemann, when, in direct contradiction to the previous statement by Binz, he regards as demonstrated that alcohol has not the power of preventing the waste of albumin in the body. [Aside from these valuable investigations, Rosemann has rendered important service by an elaborate review of some recent experiments upon the albumin-saving action of alcohol. . . . In this connection we would refer the reader to his two articles in Pflüger's "Archiv," vols. lxxvii and lxxix.]—KASSOWITZ *Is Alcohol a Food or a Poison? (a Paper)*, p. 6. (Translation by Mrs. J. H. W. STUCKENBERG.)

2425. NITROGEN OF ATMOSPHERE UNLIMITED, BUT UNASSIMILABLE—*Must Be Fixed in Soil for Plants.*—The store of nitrogen in the atmosphere is practically unlimited, but it is fixed and rendered assimilable only by cosmic processes of extreme slowness. . . . It is upon these processes, plus a return to the soil of sewage, that we must depend in the future for storing nitrogen as nitrates [in which condition only it can be of service to plants].—NEWMAN *Bacteria*, ch. 5, p. 161. (G. P. P., 1899.)

2426. NITROGEN SUPPLIED TO PLANTS BY BACTERIA—*Nitrification and Denitrification.*—The chief results of decomposition and denitrification are as follows: Free nitrogen, carbonic-acid gas and water, ammonia bodies, and sometimes nitrites. The nitrogen passes into the atmosphere and is "lost"; the carbonic acid and water return to Nature and are at once used by vegetation. The ammonia and nitrites await further changes. These further changes become necessary on account of the fact, already discussed, that plants require their nitrogen to be in the form of nitrates in order to use it. Nitrates obviously contain a considerable amount of oxygen, but ammonia contains no oxygen, and nitrites very much less than nitrates. Hence a process of oxidation is required to change the ammonia into nitrites, and the nitrites into nitrates. This oxidation is performed by the nitrifying micro-organisms, and the process is known as "nitrification." It should be clearly understood that the process of nitrification may, so to speak, dovetail with the process of denitrification.—NEWMAN *Bacteria*, ch. 5, p. 152. (G. P. P., 1899.)

2427. NOTES OF SONG-BIRD—*Tuned to Soaring and Falling Motion.*—He [the South-American field-finch] sits perched on a stalk above the grass, and at intervals soars up forty or fifty yards high; rising, he utters a series of long, melodious notes; then he descends in a graceful spiral, the set of the motionless wings giving him the appearance of a slowly falling parachute; the voice then also falls, the notes coming lower, sweeter, and more expressive until he reaches the surface. After alighting, the song continues, the strains becoming longer, thinner, and clearer, until they dwindle to the finest threads of sound and faintest tinklings, as from a cithern touched by fairy fingers. The great charm of the song is in this slow gradation from the somewhat throaty notes emitted by the bird when ascending to the excessively attenuated sounds at the close. —HUDSON *Naturalist in La Plata*, ch. 19, p. 275. (C. & H., 1895.)

2428. NUMBER OF OBJECTS POSSIBLE IN CONSCIOUSNESS—Consciousness will be at its maximum of intensity when attention is concentrated on a single object; and the question comes to be, how many single objects can the mind simultaneously survey, not with vivacity, but without absolute confusion? I find the problem stated and differently answered by different philosophers, and apparently without a knowledge of each other. By Charles Bonnet the mind is allowed to have a distinct notion of six objects at once; by Abraham Tucker the number is limited to

four, while Destutt-Tracy again amplifies it to six. The opinion of the first and last of these philosophers appears to me correct. You can easily make the experiment for yourselves, but you must beware of grouping the objects into classes. If you throw a handful of marbles on the floor you will find it difficult to view at once more than six or seven at most, without confusion: but if you group them into twos or threes or fives you can comprehend as many groups as you can units, because the mind considers these groups only as units—it views them as wholes, and throws their parts out of consideration.—HAMILTON *Metaphysics*, lect. 14, p. 176. (Sh. & Co., 1859.)

2429. ——— ——— Experiments . . . show that four and sometimes even five disconnected impressions (letters, numerals, or lines of different direction) may be distinctly perceived. If the separate impressions are so arranged that they enter into combination with one another in idea, the number becomes three times as great. Thus we are able to cognize instantly two dissyllabic words of six letters each.—WUNDT *Psychology*, lect. 16, § 2, p. 343. (Son. & Co., 1896.)

2430. NURSERY, RIMES OF, AS HISTORY—*Cradle in Tree-top.*—The first engine was run by man-power; then man subdued the horse, the ass, the camel, and invented engines for those to propel. He next domesticated the winds, the waters, the steam, the lightning; but the first common carriers and machine-power were men and women. The first burden train was women's backs; the first passenger-car was a papoose-frame. And even now, while I am speaking to you, more heavy loads are resting on human shoulders than upon all the pack-animals in the world. Hence our nursery rime:

Rock a by baby on a tree-top,
When the wind blows
The cradle will rock.
When the bough bends
The cradle will fall.
Down will come cradle,
And baby and all.

The poetry of to-day is the fact of yesterday, the dream of yesterday is the fact of to-day. When the savage woman a century or two ago, upon this very spot, strapped her dusky offspring to a rude frame, hung it upon the nearest sapling for the winds to rock, or lifted the unfortunate suckling from the ground to which it had been hurled by the bending of an unsafe bough, that was a fact, a stage in the history of invention. In our nowadays couches of down, swung from gilded hinges, we have got far ahead of the papoose-cradle, the memory of which we perpetuate in nursery rimes sung to children, who wonder why babies should be hung in the tops of trees, and think, doubtless, that the falling cradle was a just retribution on the silly parents.—MASON *The Birth of Invention (Address at Centenary of American Patent System, Washington, D. C., 1891, Proceedings of the Congress*, p. 408).

2431. NUTRITION, RESPONSE OF PLANT TO—*Rapid Absorption of Nutritious Matter by Sundew Leaf—Neglect of Useless Material.*—That the glands [of the sundew leaf] possess the power of absorption is shown by their almost instantaneously becoming dark colored when given a minute quantity of carbonate of ammonia, the change of color being chiefly or exclusively due to the rapid aggregation of their contents. When certain other fluids are added they become pale colored. Their power of absorption is, however, best shown by the widely different results which follow, from placing drops of various nitrogenous and non-nitrogenous fluids of the same density on the glands of the disk, or on a single marginal gland, and likewise by the very different lengths of time during which the tentacles remain inflected over objects which yield or do not yield soluble nitrogenous matter. This same conclusion might indeed have been inferred from the structure and movements of the leaves, which are so admirably adapted for capturing insects.—DARWIN *Insectivorous Plants*, ch. 1, p. 14. (A., 1900.)

2432. OAK THE MODEL FOR THE EDDYSTONE—*The Engineering of Nature.*—To what example, then, can we look? What better can we wish for than is supplied by that wonderful edifice which, for more than a century, braving the violence of the most destructive storms, has calmly and unintermittingly displayed its guiding light to the wave-tossed mariner, and which has furnished the pattern of every similar beacon elsewhere erected for the direction and warning of the navigator? I need not tell you to what I refer; for Smeaton and the Eddystone are household words to every Briton. . . . It was to Nature, not to the time-honored traditions of his profession, that this great practical philosopher went, when he had to deal with the problem of the Eddystone. He saw in the bole of the oak, which had stood the blasts of centuries, the shape that would not only give to his tower the greatest inherent strength, but would project upwards instead of directly resisting the dash of the impetuous waves. And he then brought all the resources of constructive skill to carry out this sagacious design, erecting on a broad and solid foundation that beautifully formed superstructure, which not only bears aloft the far-shining and welcome light, but serves as the dwelling-place for those who are charged with its maintenance.—CARPENTER *Nature and Man*, lect. 7, p. 212. (A., 1889.)

2433. OBJECTION TO NEBULAR HYPOTHESIS—*Impossible Cohesion Required of Gaseous Mass—Would Give Meteors In-*

stead of Planets.—It was objected by Professor Kirkwood in 1869 that there could be no sufficient cohesion in such an enormously diffused mass as the planets are supposed to have sprung from, to account for the wide intervals between them. The matter separated through the growing excess of centrifugal speed would have been cast off, not by rarely recurring efforts, but continually, fragmentarily, *pari passu* with condensation and acceleration. Each wisp of nebula, as it found itself unduly hurried, would have declared its independence, and set about revolving and condensing on its own account. The result would have been a meteoric, not a planetary system.—CLERKE *History of Astronomy*, pt. ii, ch. 9, p. 382. (Bl., 1893.)

2434. ——— ——— *Involves Retrograde Motion of All Planets.*—M. Faye's leading contention is that, under the circumstances assumed by Laplace, not the two outer planets alone, but the whole company must have been possessed of retrograde rotation. For they were formed—*ex hypothesi*—after the sun; central condensation had reached an advanced stage when the rings they were derived from separated; the principle of inverse squares consequently held good, and Kepler's laws were in full operation. Now particles circulating in obedience to these laws can only—since their velocity decreases outward from the center of attraction—coalesce into a globe with a backward axial movement. Nor was Laplace blind to this flaw in his theory; but his effort to remove it, tho it passed muster for the best part of a century, was scarcely successful. His planet-forming rings were made to rotate all in one piece, their outer parts thus necessarily traveling at a swifter linear rate than their inner parts, and eventually uniting, equally of necessity, into a forward-spinning body. The strength of cohesion involved may, however, safely be called impossible, especially when it is considered that nebulous materials were in question.—CLERKE *History of Astronomy*, pt. ii, ch. 9, p. 383. (Bl., 1893.)

2435. OBJECTS HELP REALIZATION—*Portraits and Toys—Explanation of Tendency to Idol-worship.*—Who does not "realize" more the fact of a dead or distant friend's existence at the moment when a portrait, letter, garment, or other material reminder of him is found? The whole notion of him then grows pungent and speaks to us and shakes us in a manner unknown at other times. In children's minds, fancies and realities live side by side. But however lively their fancies may be, they still gain help from association with reality. The imaginative child identifies its *dramatis personæ* with some doll or other material object, and this evidently solidifies belief, little as it may resemble what it is held to stand for. A thing not too interesting by its own real qualities generally does the best service here. The most useful doll I ever saw was a large cucumber in the hands of a little Amazonian-Indian girl; she nursed it and washed it and rocked it to sleep in a hammock, and talked to it all day long—there was no part in life which the cucumber did not play.—JAMES *Psychology*, vol. ii, ch. 21, p. 303. (H. H. & Co., 1899.)

2436. OBLIGATION TO MORALITY A PRIMAL CONVICTION—*All Attempts at Explanation Vain.*—Just as in the physical world there are bodies or substances which are (to us) elementary, so in the spiritual world there are perceptions, feelings, or emotions which are equally elementary—that is to say, which resist all attempts to resolve them into a combination of other and simpler affections of the mind. And of this kind is the idea, or the conception, or the sentiment of obligation. That which we mean when we say, "I ought," is a meaning which is incapable of reduction. It is a meaning which enters as an element into many other conceptions, and into the import of many other forms of expression, but it is itself uncompounded. All attempts to explain it do one or other of these two things—either they assume and include the idea of obligation in the very circumlocutions by which they profess to explain its origin, or else they build up a structure which, when completed, remains as destitute of the idea of obligation as the separate materials of which it is composed. In the one case, they first put in the gold, and then they think that by some alchemy they have made it; in the other case, they do not indeed first put in the gold, but neither in the end do they ever get it. No combination of other things will give the idea of obligation, unless with and among these things there is some concealed or unconscious admission of itself.—ARGYLL *Unity of Nature*, ch. 9, p. 191. (Burt.)

2437. OBLITERATION OF INSTINCT IN HEMISPHERELESS PIGEONS—Schrader gives a striking account of the instinctless condition of his brainless pigeons, active as they were in the way of locomotion and voice. "The hemisphereless animal moves in a world of bodies which . . . are all of equal value for him. . . . He is, to use Goltz's apt expression, impersonal. . . . Every object is for him only a space-occupying mass; he turns out of his path for an ordinary pigeon no otherwise than for a stone. He may try to climb over both. All authors agree that they never found any difference, whether it was an inanimate body, a cat, a dog, or a bird of prey which came in their pigeon's way. The creature knows neither friends nor enemies; in the thickest company it lives like a hermit. . . . As the male pays no attention to the female, so she pays none to her young. The brood may follow the mother, ceaselessly calling for food, but they might as well ask it from a

stone. . . . The hemisphereless pigeon is in the highest degree tame, and fears man as little as cat or bird of prey."—JAMES *Psychology*, vol. i, ch. 2, p. 77. (H. H. & Co., 1899.)

2438. OBSERVATION MISINTERPRETED—*Ant Recognized by Mates after Absence—Recognition Specific, Not Individual.*—How easy it is to misinterpret an observation if the very greatest care is not taken in recording it, and if it is impossible to vary the circumstances by experiment, and so obtain accurate knowledge of its conditions, is well shown by the following facts: Pierre Huber, one of the most reliable students of the habits of ants, stated that he had assured himself that an ant, if taken from the nest and returned after an interval of four months, was recognized by its former companions; for they received it friendlily, while members of a different nest, even tho they belonged to the same species, were driven away. Huber regards this as evidence of the extraordinary accuracy of memory in these insects. Now the correctness of his observation cannot be doubted; and, besides, it has been confirmed by another experienced investigator—Sir John Lubbock [Lord Avebury]. At first sight, therefore, the conclusion seems perfectly justifiable. But if a single individual were really recognized after so long an interval, think what the general mental capacity of the ants must be! Fortunately, Lubbock made the matter a subject of experiment. He took ant larvæ from the nest and did not put them back again till they were fully developed. The result was that they too were quite friendlily received. Plainly, then, there can be no question of an act of individual recognition. There must be some characteristic peculiar to all the members of a particular nest, possibly a specific odor, which determines the instinctive expression of "friendship."—WUNDT *Psychology*, lect. 23, § 1, p. 344. (M., 1898.)

2439. OBSERVATION, SCIENCE TEACHES CORRECT HABITS OF—*Mind as an Orderly Storehouse.*—To observe rightly and truly, and as science teaches us to observe, is a habit which lies at the foundation of all order in mental things; and without this habit of looking at things in their due sequence, thoughts and thinking can only appear as acts and processes which exist but to confuse and bewilder the thinker. And to the young, in their responsible duty—too little thought of in its serious nature both by pupil and teachers—of 'laying up stores of mental wealth for future use, how great a boon must be the acquirement of these orderly habits in the work of the mind! The great difficulty, I presume, of every educator of youth is not to arouse his pupils' thoughts, not to incite them to think, but to train them so to think that they shall understand, appreciate for themselves, and in due order arrange, for future use, the material which their education furnishes. For the well-balanced mind is like a duly arranged storehouse, where the fruits of each year's industry are not only duly arranged within, but are capable of being brought forth for use in good order and at the proper season and time.—ANDREW WILSON *Science-Culture for the Masses*, p. 28. (Hum., 1888.)

2440. OBSTACLES UNIMAGINED—*Boats Checked by Floating Rock—Drifting Pumice Covering the Sea.*—Every one is familiar with the fact that pumice floats upon water; this it does, not because it is a material specifically lighter than water, but because cavities filled with air make up a great part of its bulk. If we pulverize pumice we find the powder sinks readily in water, but the rock in its natural condition floats for the same reason that an iron ship does—because of the air-chambers which it encloses. When this pumice is ejected from a volcano and falls into a river or the ocean, it floats for a long time, till decomposition causes the breaking-down of the thin glassy partitions between the air-chambers, and causes the admission of water into the latter, by which means the whole mass gets water-logged. Near the Liparis and other volcanic islands the sea is sometimes covered with fragments of pumice to such an extent that it is difficult for a boat to make progress through it, and the same substance is frequently found floating in the open ocean and is cast up on every shore.—JUDD *Volcanoes*, ch. 4, p. 73. (A., 1899.)

2441. OBSTACLES, WAVES OF LIGHT FLOW AROUND—*Newton's Objection Answered—Diffraction.*—Newton, who was familiar with the idea of an ether, and who introduced it in some of his speculations, objected [nevertheless] that if light consisted of waves, shadows could not exist, for that the waves would bend round the edges of opaque bodies and agitate the ether behind them. He was right in affirming that this bending ought to occur, but wrong in supposing that it does not occur. The bending is real, tho in all ordinary cases it is masked by the action of interference. This inflection of the light receives the name of diffraction.—TYNDALL *Light*, lect. 2, p. 80. (A., 1898.)

2442. OCCIDENT AND ORIENT UNITED BY MEDITERRANEAN—*The Sea a Bond of Union.*—That which has rendered the geographical position of the Mediterranean most beneficial in its influence on the intercourse of nations is the proximity of the eastern continent, where it projects into the peninsula of Asia Minor; the number of islands in the Ægean Sea, which have served as a means for facilitating the spread of civilization, and the fissure between Arabia, Egypt, and Abyssinia, through which the great Indian Ocean penetrates under the name of the Arabian Gulf or the

Red Sea, and which is separated by a narrow isthmus from the Delta of the Nile and the southeastern coasts of the Mediterranean. By means of all these geographical relations the influence of the sea as a connecting element was speedily manifested in the growing power of the Phenicians, and subsequently in that of the Hellenic nations, and in the rapid extension of the sphere of general ideas. Civilization, in its early seats in Egypt, on the Euphrates, and the Tigris, in Indian Pentapotamia and China, had been limited to lands rich in navigable rivers; the case was different, however, in Phenicia and Hellas. The active life of the Greeks, especially of the Ionian race, and their early predilection for maritime expeditions, found a rich field for its development in the remarkable configuration of the Mediterranean, and in its relative position to the oceans situated to the south and west.—HUMBOLDT *Cosmos*, vol. ii, p. 122. (H., 1897.)

2443. OCEAN BLOCKADED BY FLOATING ROCK—*A Raft of Pumice.*—During the year 1878 masses of floating pumice were reported as existing in the vicinity of the Solomon Isles, and covering the surface of the sea to such extent that it took ships three days to force their way through them. Sometimes these masses of pumice accumulate in such quantities along coasts that it is difficult to determine the position of the shore within a mile or two, as we may land and walk about on the great floating raft of pumice.—JUDD *Volcanoes*, ch. 4, p. 73. (A., 1899.)

2444. OCEAN, FREEDOM OF COMMUNICATION IN—*Fauna of the Sea—More Difficult to Divide than That of the Land.*—On the dry land we find mountain ranges, forests, deserts, and other barriers that to a very considerable extent prevent the mixing of one fauna with another, but in the sea there are no barriers of anything like the same importance, but one fauna gradually merges into the neighboring fauna according to the temperature, the pressure, the amount of light, the salinity of the water, or the food-supply. This, then, is one of the difficulties met with in the study of the geographical distribution of the marine fauna.—HICKSON *Fauna of the Deep Sea*, ch. 3, p. 46. (A., 1894.)

2445. OCEAN, PHOSPHORESCENCE OF—*Manifold Light and Life of the Deep.*—As the moon passes behind a cloud, and the night grows darker for the obscuring of the Queen of the Night, this strange light on the waves literally glows with its fiery sheen. . . . Look how every fleck of spray seems tinged with a radiance as of jeweled kind. Flashes of lambent fire play among the foam, and now and then a long ripple of flame shoots along the whole course of the wave that rushes aft from the bow.

Suppose you could lift a bucket of water from the sea to-night, and that in your deck-cabin you had your microscope in full array, let us endeavor to see what such a scrutiny of the waves would tell us about the cause of the phosphorescence of the deep. The water would be seen to be alive with animalcules, each the mere fraction of an inch in length. . . .

Swarming in myriads in the waters of the ocean, these animalcules, under favorable conditions of heat and other phases relating to their vital activity, give forth the strange, weird gleam you see shooting along the crest of the waves. You can recall Coleridge's lines with apt force when on this quiet night you sit and watch the play of phosphorescence on the sea:

> Beyond the shadow of the ship I watched the water-snakes;
> They moved in tracks of shining white,
> And when they neared the elfish light
> Fell off in hoary flakes.
>
> Beyond the shadow of the ship I watched their rich attire;
> Blue, glossy green, and velvet black,
> They coiled and swam, and every track
> Was a flash of golden fire.

How and why these and other animals exhibit a phosphorescent light is a problem towards the solution of which science has, at least, advanced within reasonable distance. The noctiluca is undoubtedly the cause of the diffused phosphorescence of the sea. The myriads of animalcules give to the ocean the appearance of a universal effulgence.—ANDREW WILSON *Glimpses of Nature*, ch. 2, p. 11. (Hum., 1892.)

2446. ——— ——— *Night Made Glorious—Luxuriance of Beauty.*—The phosphorescence of the ocean is one of those splendid phenomena of Nature which excite our admiration, even when we behold its recurrence every night for months together. The ocean is phosphorescent in all zones of the earth, but he who has not witnessed the phenomenon in the tropics, and especially in the Pacific, can form but a very imperfect idea of the majesty of this brilliant spectacle. The traveler on board a man-of-war, when plowing the foaming waves before a fresh breeze, feels that he can scarcely satisfy himself with gazing on the spectacle presented by the circling waves. Wherever the ship's side rises above the waves, bluish or reddish flames seem to flash lightning-like upwards from the keel. The appearance presented in the tropical seas on a dark night is indescribably glorious, when shoals of dolphins are seen sporting around, and cutting the foaming waves in long and circling lines, gleaming with bright and sparkling light.—HUMBOLDT *Views of Nature*, p. 245. (Bell, 1896.)

2447. OCEAN, POSSIBLE IRRUPTION OF—The second case [of a possible deluge] is where there are large tracts of dry land beneath the mean level of

the ocean. It seems, after much controversy, to be at length a settled point that the Caspian is really 83 feet 6 inches lower than the Black Sea. As the Caspian covers an area about equal to that of Spain, and as its shores are in general low and flat, there must be many thousand square miles of country less than 83 feet above the level of that inland sea, and consequently depressed below the Black Sea and Mediterranean. This area includes the site of the populous city of Astrakhan and other towns. Into this region the ocean would pour its waters, if the land now intervening between the Sea of Azof and the Caspian should subside. Yet even if this event should occur, it is most probable that the submergence of the whole region would not be accomplished simultaneously, but by a series of minor floods, the sinking of the barrier being gradual.—LYELL *Principles of Geology*, bk. i, ch. 10, p. 156. (A., 1854.)

2448. OCEAN DEPTHS SUPPOSED TO BE LIFELESS—Our knowledge of the natural history of the deep seas may be said to have commenced not more than fifty years ago. There are, it is true, a few fragments of evidence of a fauna existing in depths of more than a hundred fathoms to be found in the writings of the earlier navigators, but the methods of deep-sea investigation were so imperfect in those days that naturalists were disposed to believe that in the abysses of the great oceans life was practically non-existent.—HICKSON *Fauna of the Deep Sea*, ch. 1, p. 2. (A., 1894.)

2449. OCEAN FLOOR OF THE NORTH ATLANTIC—*A Vast Plain—Depths Where Mont Blanc Might Be Sunk.*—The result of all these operations [soundings for the cable] is that we know the contours and the nature of the surface-soil covered by the North Atlantic, for a distance of 1,700 miles from east to west, as well as we know that of any part of the dry land. It is a prodigious plain—one of the widest and most even plains in the world. If the sea were drained off you might drive a wagon all the way from Valentia, on the west coast of Ireland, to Trinity Bay, in Newfoundland. And, except upon one sharp incline about 200 miles from Valentia, I am not quite sure that it would even be necessary to put the skid on, so gentle are the ascents and descents upon that long route. From Valentia the road would lie down-hill for about 200 miles to the point at which the bottom is now covered by 1,700 fathoms of sea-water. Then would come the central plain, more than a thousand miles wide, the inequalities of the surface of which would be hardly perceptible, tho the depth of water upon it now varies from 10,000 to 15,000 feet; and there are places in which Mont Blanc might be sunk without showing its peak above water. Beyond this, the ascent on the American side commences and gradually leads for about 300 miles to the Newfoundland shore.—HUXLEY *Lay Sermons*, serm. 14, p. 182. (G. P. P., 1899.)

2450. OLD AND NEW UNITE TO MAKE CONSISTENT SYSTEM—The great merit of Cope's work on mammals is that he always considered the old and new—the extinct and recent—forms together. He refused to be bound by consistency or by precedent, either set by himself or others. Fresh discoveries opened new vistas to him, and he modified his views from time to time and as often as he received new evidence.—GILL *Address in Memory of Edward Drinker Cope* in *Proceedings of Amer. Assoc. for Advancement of Science*, vol. xlvi, 1897.

2451. OMEN FULFILS ITSELF—*Halley's Comet at Battle of Hastings.*—The comet of Halley appeared again in 1066, at the time when William the Conqueror invaded England. The chroniclers unanimously write, "The Normans, guided by a comet, invaded England." The Duchess-Queen Matilda, wife of William, has represented this comet and the amazement of her subjects on the tapestry (230 feet long), which may be seen at Bayeux. Queen Victoria has in her crown a jewel the design of which was suggested by the tail of this comet, which had the greatest influence on the victory at Hastings.—FLAMMARION *Popular Astronomy*, bk. v, ch. 1, p. 479. (A.)

2452. OMEN REVERSED BY SCIENCE—*Serviceableness of the Screech-owl.*—We do not think of owls as being insectivorous birds, but Dr. A. K. Fisher tells us that of 225 screech-owls' stomachs examined, 100 contained insects. As 91 of the remaining 125 contained mice, and poultry was found in only one stomach, the farmer may well consider the screech-owl a bird of good repute rather than of ill omen.—CHAPMAN *Bird-Life*, ch. 7, p. 130. (A., 1900.)

2453. OMISSION BY ANCIENT WRITER—*A Common Bird Left without Mention.*—It is a remarkable fact that Molina, tho describing in detail all the birds and animals of Chile, never once mentions this genus [*Pteroptochos*], the species of which are so common and so remarkable in their habits. Was he at a loss how to classify them, and did he consequently think that silence was the more prudent course? It is one more instance of the frequency of omissions by authors, on those very subjects where it might have been least expected.—DARWIN *Naturalist's Voyage around the World*, ch. 12, p. 271 (note). (A., 1893.)

2454. OMNISCIENCE IS FOREKNOWLEDGE—*One Knowing All Factors of Decision Could Predict Result.*—Processes [of will] may be compared to a man on a journey who proceeds from a certain point on foot by short stages, at any given time,

and in any direction. He has then the choice of an infinite number of routes over the whole earth. If such a man begins his wanderings in obedience to the impulse of his own will, his own pleasure or interest—proceeding forwards, to the right or left, or even backwards, with longer or shorter pauses, and starting at any particular time—it is obvious that the route taken lies in the man himself and is determined by his own peculiar temperament. His judgment, experience, and inclination will influence his course at each turn of his journey, as new circumstances arise. He will turn aside from a mountain which he considers too lofty to be climbed; he will incline to the right if this direction appears to afford a better passage over a swollen stream; he will rest when he reaches a pleasant halting-place, and will hurry on when he knows that enemies beset him. And in spite of the perfectly free choice open to him, the course he takes is in fact decided by both the place and time of his starting and by circumstances which—always occurring at every part of the journey—impel him one way or the other; and if all the factors could be ascertained in the minutest detail his course could be predicted from the beginning.—WEISMANN *Heredity*, vol. i, p. 138. (Cl. P., 1891.)

2455. ONTOGENESIS AND PHYLOGENESIS—*Embryological Development Not Parallel with Geological.*—*Ontogenesis* is the embryonic development of the individual animal, and is, of course, a short process, depending on the production of a germ by a parent animal or parent pair, and the further growth of this germ in connection more or less with the parent or with provision made by it. This is, of course, a fact open to observation and study, tho some of its processes are mysterious and yet involved in doubt and uncertainty. *Phylogenesis* is the supposed development of a species in the course of geological time and by the intervention of long series of species, each in its time distinct and composed of individuals each going regularly through a genetic circle of its own.

The latter is a process not open to observation within the time at our command—purely hypothetical, therefore, and of which the possibility remains to be proved; while the causes on which it must depend are necessarily altogether different from those at work in *ontogenesis*, and the conditions of a long series of different kinds of animals, each perfect in its kind, are equally dissimilar from those of an animal passing through the regular stages from infancy to maturity. The similarity, in some important respects, of *ontogenesis* to *phylogenesis*, was inevitable, provided that animals were to be of different grades of complexity, since the development of the individual must necessarily be from a more simple to a more complex condition. On any hypothesis, the parallelism between embryological facts and the history of animals in geological time affords many interesting and important coincidences. Yet it is perfectly obvious that the causes and the conditions of these two successions cannot have been the same.—DAWSON *Facts and Fancies in Modern Science*, lect. 1, p. 65. (A. B. P. S.)

2456. OPINIONS ON AUTHORITY—*Agreement of Specialists the Test.*—It is, without doubt, the necessary condition of mankind to receive most of their opinions on the authority of those who have specially studied the matters to which they relate. The wisest can act on no other rule, on subjects with which they are not themselves thoroughly conversant; and the mass of mankind have always done the like on all the great subjects of thought and conduct, acting with implicit confidence on opinions of which they did not know, and were often incapable of understanding the grounds, but on which, as long as their natural guides were unanimous, they fully relied, growing uncertain and skeptical only when these became divided, and teachers who, as far as they could judge, were equally competent, professed contradictory opinions. Any doctrines which come recommended by the nearly universal verdict of instructed minds will no doubt continue to be, as they have hitherto been, accepted without misgiving by the rest.—MILL *Positive Philosophy of Auguste Comte*, p. 90. (H. H. & Co., 1887.)

2457. OPPORTUNITY IN LINE OF NATURAL TENDENCY—*A Time When Each Acquirement Is Easy.*—In all pedagogy the great thing is to strike the iron while hot, and to seize the wave of the pupil's interest in each successive subject before its ebb has come, so that knowledge may be got and a habit of skill acquired—a headway of interest, in short, secured, on which afterward the individual may float. There is a happy moment for fixing skill in drawing, for making boys collectors in natural history, and presently dissectors and botanists; then for initiating them into the harmonies of mechanics and the wonders of physical and chemical law. Later, introspective psychology and the metaphysical and religious mysteries take their turn; and, last of all, the drama of human affairs and worldly wisdom in the widest sense of the term. In each of us a saturation-point is soon reached in all these things; the impetus of our purely intellectual zeal expires, and unless the topic be one associated with some urgent personal need that keeps our wits constantly whetted about it, we settle into an equilibrium and live on what we learned when our interest was fresh and instinctive, without adding to the store.—JAMES *Psychology*, vol. ii, ch. 24, p. 401. (H. H. & Co., 1899.)

2458. OPPOSITES CONNECTED BY INSENSIBLE GRADATIONS—*Circle, Ellipse, Parabola, Hyperbola, Straight Line*

Merge into Each Other.—There is no apparent similarity between a straight line and a circle. The one is a curve; the other is defined as without curvature. The one encloses a space; the other will not enclose a space, tho produced forever. The one is finite; the other may be infinite. Yet, opposite as the two are in their characters, they may be connected together by a series of lines no one of which differs from the adjacent ones in any appreciable degree. Thus, if a cone be cut by a plane at right angles to its axis we get a circle. If, instead of being perfectly at right angles, the plane subtends with the axis an angle of 89° 59′, we have an ellipse which no human eye, even when aided by an accurate pair of compasses, can distinguish from a circle. Decreasing the angle minute by minute, this closed curve becomes perceptibly eccentric, then manifestly so, and by and by acquires so immensely elongated a form as to bear no recognizable resemblance to a circle. By continuing this process the ellipse changes insensibly into a parabola. On still further diminishing the angle the parabola becomes an hyperbola. And finally, if the cone be made gradually more obtuse, the hyperbola passes into a straight line as the angle of the cone approaches 180°. Here, then, we have five different species of line—circle, ellipse, parabola, hyperbola, and straight line —each having its peculiar properties and its separate equation, and the first and last of which are quite opposite in Nature, connected together as members of one series, all producible by a single process of insensible modification.—SPENCER *Biology*, pt. iii, ch. 3, p. 433. (A., 1900.)

2459. OPPOSITES UNITED—*The Luminiferous Ether Has Gascous Tenuity, with Properties of a Solid.*—The notion of this medium must not be considered as a vague or fanciful conception on the part of scientific men. Of its reality most of them are as convinced as they are of the existence of the sun and moon. The luminiferous ether has definite mechanical properties. It is almost infinitely more attenuated than any known gas, but its properties are those of a solid rather than of a gas. It resembles jelly rather than air. This was not the first conception of the ether, but it is that forced upon us by a more complete knowledge of its phenomena. A body thus constituted may have its boundaries; but, altho the ether may not be coextensive with space, it must at all events extend as far as the most distant visible stars. In fact, it is the vehicle of their light, and without it they could not be seen. This all-pervading substance takes up their molecular tremors, and conveys them with inconceivable rapidity to our organs of vision. It is the transported shiver of bodies countless millions of miles distant, which translates itself in human consciousness into the splendor of the firmament at night.—TYNDALL *Fragments of Science*, vol. i, ch. 1, p. 4. (A., 1897.)

2460. OPPOSITION, DELIGHT IN—*Mental as Distinguished from Physical Combativeness—Perception of Dangers and Difficulties.*—There are individuals who never manifest the least degree of physical combativeness, who yet show a remarkable love of opposition in all their psychical relations with others. That objections will be raised by such persons to any plan that may be proposed we can always feel sure, tho we may not have the remotest idea as to what the objection may be in each particular case. Persons in whom this tendency exists in a less prominent degree are apt to see objections and difficulties first, altho their good sense may subsequently lead them to consider these as of less account or to be outweighed by the advantages of the scheme. Such was the case with the late Sir Robert Peel. On the other hand, those who are spoken of as of sanguine temperament are apt to lose sight of the intervening difficulties, in the pleasurable anticipation of the result.—CARPENTER *Mental Physiology*, ch. 7, p. 317. (A., 1900.)

2461. OPPRESSION HATEFUL—*Science Despises Tyrants' Petty Grandeur—Solicitude for Humanity.*—I have said that no arts of importance have been lost, but perhaps this assertion is rather too general. There is one which may be considered an exception: I allude to the ancient art possessed by the few of enslaving and brutalizing the many, the art by which a single individual, invested with the magic of kingly power, was enabled to compel thousands of his subjects, through the course of a long reign, like beasts of burden, to haul materials and heap up huge piles of stone, which might transmit to posterity the fact that a worm like himself had lived and died. The pyramids of Egypt, venerable as they are with the age of accumulated centuries, are melancholy monuments of human degradation, of human vanity and cruelty.—HENRY *Improvement of the Mechanical Arts, Scientific Writings*, vol. i, p. 321. (Sm. Inst., 1886.)

2462. ORDER AMID SEEMING ACCIDENTS—*Periodicity of Sun-spots.*—Schwabe found that in the course of about eleven years the solar spots pass through a complete cycle of changes. They become gradually more and more numerous up to a certain maximum, and then as gradually diminish. At length the sun's face becomes not only clear of spots, but a certain well-marked darkening around the border of his disk disappears altogether for a brief season. At this time the sun presents a perfectly uniform disk. Then gradually the spots return, become more and more numerous, and so the cycle of changes is run through again.

The astronomers who have watched the sun from the Kew Observatory have found

that the process of change by which the spots sweep in a sort of "wave of increase" over the solar disk is marked by several minor variations. As the surface of a great sea-wave will be traversed by small ripples, so the gradual increase and diminution in the number of the solar spots is characterized by minor gradations of change, which are sufficiently well marked to be distinctly cognizable. There seems every reason for believing that the periodic changes thus noticed are due to the influence of the planets upon the solar photosphere, tho in what way that influence is exerted is not at present perfectly clear.—PROCTOR *Other Worlds than Ours*, ch. 2, p. 39. (Burt.)

2463. ORDER OF EVOLUTION REVERSED—*Mental Disorder Wrecks Higher Structures First.*—We may, perhaps, express this point of connection between the illusions of normal life and insanity by help of a physiological hypothesis. If the nervous system has been slowly built up, during the course of human history, into its present complex form, it follows that those nervous structures and connections which have to do with the higher intellectual processes, or which represent the larger and more general relations of our experience, have been most recently evolved. Consequently, they would be the least deeply organized, and so the least stable; that is to say, the most liable to be thrown *hors de combat*. This is what happens temporarily in the case of the sane, when the mind is held fast by an illusion. And in states of insanity we see the process of nervous dissolution beginning with these same nervous structures, and so taking the reverse order of the process of evolution. And thus, we may say that throughout the mental life of the most sane of us these higher and more delicately balanced structures are constantly in danger of being reduced to that state of inefficiency which in its full manifestation is mental disease.—SULLY *Illusions*, ch. 6, p. 122. (A., 1897.)

2464. ORDER REQUIRES ORGANIZING MIND—*Philosophy an Antidote to Atheism.*—I had rather believe all the fables in the legend, and the Talmud and the Alcoran, than that this universal frame is without a mind; and, therefore, God never wrought miracle to convince atheism, because his ordinary works convince it. It is true that a little philosophy inclineth man's mind to atheism, but depth in philosophy bringeth men's minds about to religion; for while the mind of man looketh upon second causes scattered, it may sometimes rest in them and go no further; but when it beholdeth the chain of them confederate and linked together it must needs fly to Providence and Deity: nay, even that school which is most accused of atheism doth most demonstrate religion: that is, the school of Leucippus, and Democritus, and Epicurus; for it is a thousand times more credible that four mutable elements and one immutable fifth essence, duly and eternally placed, need no God, than that an army of infinite small portions, or seeds unplaced, should have produced this order and beauty without a divine marshal.—BACON *Essays*, essay 16, *Of Atheism*, p. 58. (W. L. A.)

2465. ORDER, UNCHANGING, OF THE STARRY HOST—*The Pleiades.*—When we look up at the heavens we see, if we watch through the night, the host of stars rising in the east and passing above us to sink in the west, always at the same distance and in unchanging order, each seeming a point of light as feeble as the glowworm's shine in the meadow over which they are rising, each flickering as tho the evening wind would blow it out. The infant stretches out its hand to grasp the Pleiades; but when the child has become an old man the "seven stars" are still there unchanged, dim only in his aged sight, and proving themselves the enduring substance, while it is his own life which has gone, as the shine of the glowworm in the night. They were there just the same a hundred generations ago, before the pyramids were built, and they will tremble there still, when the pyramids have been worn down to dust with the blowing of the desert sand against their granite sides. They watched the earth grow fit for man long before man came, and they will doubtless be shining on when our poor human race itself has disappeared from the surface of this planet.—LANGLEY *New Astronomy*, ch. 5, p. 117. (H. M. & Co., 1896.)

2466. ORGANISM DETERMINES DISEASE—*Bacteria Exciting Causes.*—Whatever may be said with regard to the power of micro-organisms to cause disease, we must understand one cardinal point, namely, that bacteria are never more than causes, for the nature of disease depends upon the behavior of the organs or tissues with which the bacteria or their products meet.—NEWMAN *Bacteria*, ch. 8, p. 267. (G. P. P., 1899.)

2467. ORGANISM MORE CONTROLLING THAN CONDITIONS—In variation under domestication there are two factors, namely, the nature of the organism and the nature of the conditions. The former seems to be much the more important; for nearly similar variations sometimes arise under, as far as we can judge, dissimilar conditions; and, on the other hand, dissimilar variations arise under conditions which appear to be nearly uniform.—DARWIN *Origin of Species*, ch. 1, p. 9. (Burt.)

2468. ORGANISMS, HIGHER, MAY COOPERATE WITH LOWER—Higher organisms [may be] associated for a specific purpose with bacteria. . . . [It is believed that these] perform a preliminary disintegration of organic matter before the decomposing bacteria commence their la-

bors. This occurs apparently in the self-purification of rivers, as well as in polluted soils.—NEWMAN *Bacteria*, ch. 1, p. 33. (G. P. P., 1899.)

2469. ORGANISMS, LOWER, HELP HIGHER—*Microbes Fix Nitrogen for Plants—Nitrates.*—Until comparatively recently it was held that plant life could not be maintained in a soil devoid of nitrogen or compounds thereof. But it has been found that certain classes of plants (the *Leguminosæ*, for example), when they are grown in a soil which is practically free from nitrogen at the commencement, do take up this gas into their tissues. One explanation of this fact is that free nitrogen becomes converted into nitrogen compounds in the soil through the influence of micro-organisms present there. Another explanation attributes this fixation of free nitrogen to micro-organisms existing in the rootlets of the plant. . . . The main supply of this gas, absolutely necessary to the existence of vegetable life upon the earth, is drawn not from the nitrogen of the atmosphere, but from that contained in nitrogen compounds in the soil. The most important of these are the nitrates. Here, then, we have the necessary food of plants expressed in a sentence: water, gases, salts, the most important and essential gas and some of the salts being combined in nitrates.—NEWMAN *Bacteria*, ch. 5, p. 147. (G. P. P., 1899.)

2470. ORGANISMS, MICROSCOPIC, INCONCEIVABLY NUMEROUS—*Protected Infusions Void of Life.*—Sixty flasks filled, boiled, and sealed [hermetically], and containing strong infusions of beef, mutton, turnip, and cucumber, are carefully packed in sawdust, and transported to the Alps. . . . We open our box at the Bel Alp and count out fifty-four flasks, with their liquids as clear as filtered drinking-water. In six flasks, however, the infusion is found muddy. We closely examine these, and discover that every one of them has had its fragile end broken off in the transit from London. Air has entered the flasks, and the observed muddiness is the result. . . . Examined with a pocket lens, or even with a microscope of insufficient power, nothing living is seen in the muddy liquid; but regarded with a magnifying power of a thousand diameters or so, what an astonishing appearance does it present! Leeuwenhoek estimated the population of a single drop of stagnant water at 500,000,000: probably the population of a drop of our turbid infusion would be this many times multiplied. The field of the microscope is crowded with organisms, some wabbling slowly, others shooting rapidly across the microscopic field. They dart hither and thither like a rain of minute projectiles; they pirouette and spin so quickly round that the retention of the retinal impression transforms the little living rod into a twirling wheel. And yet the most celebrated naturalists tell us they are vegetables. From the rod-like shape which they so frequently assume, these organisms are called "bacteria"—a term, be it here remarked, which covers organisms of very diverse kinds.—TYNDALL *Floating Matter of the Air*, essay 3, p. 292. (A., 1895.)

2471. ORGANISMS NEITHER PLANT NOR ANIMAL—*Moving Plants among Rooted Animals—Animals Secreting Chlorophyl—Plants Eating Insects.*—There is a limbo filled with organisms which never rise high enough in the scale to be manifestly either animal or plant, unless it may be said of some of them that they are each in turn and neither long. There are undoubted animals which produce the essential material of vegetable fabric, or build up a part of their structure of it, or elaborate the characteristic *leaf-green* [chlorophyl] which, under solar light, assimilates inorganic into organic matter, the most distinguishing function of vegetation. On the other hand, there are plants—microscopic, indeed, but unquestionable—which move spontaneously and freely around and among animals that are fixed and rooted. And, to come without further parley to the matter in hand, while the majority of animals feed directly upon plants, "for 'tis their nature to," there are plants which turn the tables and feed upon them. Some, being parasitic upon living animals, feed insidiously and furtively; these, altho really cases in point, are not so extraordinary, and, as they belong to the lower orders, they are not much regarded, except for the harm they do. There are others, and those of the highest orders, which lure or entrap animals in ways which may well excite our special wonder, all the more so since we are now led to conclude that they not only capture but consume their prey.—GRAY *Darwiniana*, art. 10, p. 289. (A., 1889.)

2472. ORGANISMS, SOCIAL, IN ECONOMY OF NATURE—*Coral Reefs and Islands.*—As minute social organisms, the corals play an important part in the general economy of Nature, altho they do not, as people began to believe after Captain Cook's voyages of discovery, build up islands or enlarge continents from almost unfathomable depths of the ocean. They excite the liveliest interest, whether regarded as physiological objects, and as illustrating the various gradations of animal form, or in connection with the geography of plants and the geognostic relations of the earth's crust. According to the comprehensive views of Leopold von Buch, the whole Jura-formation consists of "large elevated coral-banks of the ancient world, surrounding at a certain distance the old mountain chains."—HUMBOLDT *Views of Nature*, p. 252. (Bell, 1896.)

2473. ORGANIZATION NOT THE CAUSE OF LIFE—*Vital Force Organizes Matter.*—We never see the phenomena of

life dissociated from organization. Yet the profoundest physiologists have come to the conclusion that organization is not the cause of life, but, on the contrary, that life is the cause of organization—life being something—a force of some kind, by whatever name we may call it—which precedes organization, and fashions it, and builds it up. This was the conclusion come to by the great anatomist Hunter, and it is the conclusion indorsed in our own day by such men as Dr. Carpenter and Professor Huxley—men neither of whom have exhibited in their philosophy any undue bias towards either theological or metaphysical explanations.—ARGYLL *Reign of Law*, ch. 2, p. 71. (Burt.)

2474. ORGANIZATION OF INDUSTRY—*Cooperative Building among Primitive Men.*—To drag the piles to the lake, and fix them firmly [as supports for lake-dwellings], must also have required much labor, especially when their number is considered. At Wangen alone M. Lohle has calculated that 50,000 piles were used; but we must remember that these were probably not all planted at one time nor by one generation. Wangen, indeed, was certainly not built in a day, but was, no doubt, gradually enlarged as the population increased. Herodotus informs us that the Pæonians [an ancient race of lake-dwellers] made the first platform at the public expense, but that, subsequently, at every marriage (and polygamy was permitted), the bridegroom was expected to add a certain number of piles to the common support.—AVEBURY *Prehistoric Times*, ch. 6, p. 177. (A., 1900.)

2475. ORGANIZATION OF LABOR—*Combination against Competition.*—A moment's consideration will convince us that the same necessities of labor which were found to determine so fatally the condition of women and children are necessities which apply without any abatement to the labor of adult men. . . . If a man is placed under such conditions that he cannot save his wife and child from exhausting labor it is certain that the same conditions will impose a like necessity upon himself. Nevertheless, Parliament has resolutely and wisely refused to interfere on his behalf. And why? Because the argument is that the adult man is able, or ought to be able, to defend himself. And so he can; but how? Only by combination. The "law" which results in excessive labor is the law of competition—that is, it is the attraction exerted upon the wills of a multitude of individual men by the rewards of labor. The pressure of this attraction can only be lightened by bringing those wills under the power of counter-motives, which may induce them to postpone, to some higher interest, the immediate appetites of gain. And this is the work which combination does.—ARGYLL *Reign of Law*, ch. 7, p. 221. (Burt.)

2476. ORGANS OF SENSE BEYOND MAN'S KEN—*Mysterious Power of Antennæ.*—The antennæ appear to be the most important of the sense-organs [of ants], as their removal produces an extraordinary disturbance in the intelligence of the animal. An ant so mutilated can no longer find its way or recognize companions, and therefore is unable to distinguish between friends and foes. It is also unable to find food, ceases to engage in any labor, and loses all its regard for larvæ, remaining permanently quiet and almost motionless. A somewhat similar disturbance, or rather destruction, of the mental faculties is observable as a result of the same mutilation in the case of bees.—ROMANES *Animal Intelligence*, ch. 3, p. 142. (A., 1899.)

2477. ORGANS, RUDIMENTARY—*A True Teleology—Unity of Plan.*—By the adoption of the Darwinian hypothesis, or something like it, which we incline to favor, many of the difficulties are obviated and others diminished. In the comprehensive and far-reaching teleology which may take the place of the former narrow conceptions, organs and even faculties, useless to the individual, find their explanation and reason of being. Either they have done service in the past, or they may do service in the future. They may have been essentially useful in one way in a past species, and, tho now functionless, they may be turned to useful account in some very different way hereafter. In botany several cases come to our mind which suggest such interpretation.—ASA GRAY *Darwiniana*, art. 13, p. 375. (A., 1889.)

2478. ——— ——— *Muscles for Moving the Ears in Man.*—Moreover, most of the higher animals possess muscles which are never employed; even man has such rudimentary muscles. Most of us are incapable of moving our ears as we wish, altho the muscles for this movement exist, and altho individual persons who have taken the trouble to exercise these muscles do succeed in moving their ears. It is still possible, by special exercise, by the persevering influence of the will upon the nervous system, to reanimate the almost extinct activity in the existing but imperfect organs, which are on the road to complete disappearance.—HAECKEL *History of Creation*, vol. i, ch. 1, p. 12. (K. P. & Co., 1899.)

2479. ——— ——— *One Vast Plan of Organic Life.*—These useless members, these rudimentary or aborted limbs which puzzled us so much, are parts of an universal plan. On this plan the bony skeletons of all living animals have been put together. The forces which have been combined for the molding of organic forms have been so combined as to mold them after certain types or patterns. And when comparative anatomy has revealed this fact as affecting all the animals of the existing world, another branch

of the same science comes in to confirm the generalization, and extend it over the innumerable creatures which have existed and have passed away. This one plan of organic life has never been departed from since time began.—ARGYLL *Reign of Law,* ch. 4, p. 117. (Burt.)

2480. ORGANS, STIMULUS, GROWTH, AND DECAY OF—*Some Laws in Pedagogy.*—"A vigorously used organ withdraws nourishment from the neighboring organs and hinders their development."

"An organ that is not used loses its energy."

"An organ overstrained easily becomes useless."

"When a single function suffers, all the others suffer with it, and harmonious development is out of the question."

"Organic development proceeds from the inner to the outer; the reverse process is impossible."

"Artificial stimulus to growth leads to decay."

"The separate functions succeed each other, but they do not appear simultaneously."

"Only that which develops slowly is capable of long development."—VAIHINGER *Address before Scientists.* (Translated for *Scientific Side-Lights.)*

2481. ORIGIN AND ANTIQUITY OF MAN—*Likeness to and Difference from Lower Animals—Unity of Nature a Unity of Plan.*—Man, when regarded merely as an organism, is closely related to the lower animals. His body is constructed on the same general plan with theirs. More especially, he is near akin to the other members of the class *Mammalia.* But we must not forget that even as an animal man is somewhat widely separated from his humbler relations. . . . It is easy to say that every bone, every muscle, every convolution of his brain, has its counterpart in the corresponding parts of an orang or a gorilla. But, admitting this, it is also true that every one of these parts is different, and that the aggregate of all the differences mounts up to an enormous sum total, more especially in relation to habits and to capacities for action. Those remarkable homologies or likenesses of plan which obtain in the animal kingdom are very wonderful, and the study of them greatly enlarges our conceptions of the unity of Nature; but we must never forget that such general agreements in plan cover the most profound differences in detail and in adaptation to use, and that, while they indicate a common type, this may rather point to a unity of design than to a mere accidental unity of descent.—DAWSON *Facts and Fancies in Modern Science,* lect. 4, p. 139. (A. B. P. S.)

2482. ORIGIN OF DEEP-SEA LIFE—*No Close Resemblance to Geologic Fauna.*—Whence came the curious creatures that live mostly in total darkness and can sustain without injury to their delicate and complicated organization the enormous pressure of the great depths? Are they the remnants of the fauna of shallow prehistoric seas that have reached their present position by the gradual sinking of the ocean basins? Or, are we to look upon the abysmal region as the nursery of the marine fauna, the place whence the population of the shallow waters was derived? Neither of these answers is supported by the facts with which we are now well acquainted. The fauna of the abysmal region does not show a close resemblance to that of any of the past epochs as revealed to us by geology, nor are we justified in assuming, without much stronger evidence than we now possess, that the oceans have undergone any such great depression as this first theory presupposes.—HICKSON *Fauna of the Deep Sea,* ch. 3, p. 54. (A., 1894.)

2483. ORIGIN OF GEOMETRY—*Man Loves to Divide Space.*—The whole science of geometry may be said to owe its being to the exorbitant interest which the human mind takes in lines. We cut space up in every direction in order to manufacture them.—JAMES *Psychology,* vol. ii, ch. 20, p. 150. (H. H. & Co., 1899.)

2484. ORIGIN OF MARINER'S COMPASS FOREVER LOST—*Magnetism Known, Polarity Unsuspected.*—How or when the tendency of a freely suspended magnet to set itself in a nearly north and south direction was first discovered is a question, the answer to which is probably forever lost. The civilized world remained in ignorance of the fact for nearly eighteen centuries after the attractive effect of the lodestone had become well known. Altho, as I have already stated, it is not impossible to conjecture that the phenomenon was familiar to the ancestors of primitive civilization, who, from the highlands of Central Asia, dispersed in many races over the earth; yet the knowledge came to the people of the Middle Ages anew, through the invention of the first and greatest of electrical instruments—the mariner's compass; first, in its utilization of the mysterious force existing in the magnet; greatest, in that it has contributed more than any other product of human intelligence to the progress and welfare of mankind.—PARK BENJAMIN *Intellectual Rise in Electricity,* ch. 3, p. 53. (J. W., 1898.)

2485. ORIGIN OF NAME "GORILLA"—*Voyage of Hanno from Carthage.*—About twenty-five centuries ago a voyager called Hanno is said to have sailed from Carthage, between the Pillars of Hercules—that is, through the Straits of Gibraltar—along the shores of Africa. "Passing the Streams of Fire," says the narrator, "we came to a bay called the Horn of the South. In the recess there was an island, . . .

having a lake, and in this there was another island full of wild men. But much the greater part of them were women with hairy bodies, whom the interpreters called 'Gorillas.' Pursuing them, we were not able to take the men; they all escaped, being able to climb the precipices, and defended themselves with pieces of rock. But three women, who bit and scratched those who led them, were not willing to follow. However, having killed them, we flayed them and conveyed the skins to Carthage. . . ."

In the opinion of many naturalists, the wild men of this story were the anthropoid or manlike apes which are now called gorillas, rediscovered recently by Du Chaillu. . . . I must confess these inferences seem to me somewhat open to question, and the account of Hanno's voyage only interesting in its relation to the gorilla as having suggested the name now given to this race of apes. It is not probable that Hanno sailed much further than Sierra Leone. . . . The behavior of the "wild men," again, does not correspond with the known habits of the gorilla.—PROCTOR *Pleasant Ways in Science*, p. 296. (L. G. & Co., 1895.)

2486. ORIGIN OF RELIGION—*Assumptions Regarding a Divine Being.*—Men have been very busy of late in speculating on the origin of religion. In asking this question they generally make, often as it seems unconsciously, one or other of two assumptions. One is the assumption that there is no God, and that it must have taken a long time to invent him. The other is that there is a God, but that men were born, or created, or developed, without any sense or feeling of his existence, and that the acquisition of such a sense must of necessity have been the work of time.—ARGYLL *Unity of Nature*, ch. 11, p. 265. (Burt.)

2487. ORIGIN OF STATES OF CONSCIOUSNESS UNKNOWN—It must be frankly confessed that in no fundamental sense do we know where our successive fields of consciousness come from, or why they have the precise inner constitution which they do have. They certainly follow or accompany our brain states, and, of course, their special forms are determined by our past experiences and education. But, if we ask just *how* the brain conditions them, we have not the remotest inkling of an answer to give.—JAMES *Talks to Teachers*, ch. 2, p. 16. (H. H. & Co., 1900.)

2488. ORIGIN OF VARIATIONS UNEXPLAINED—*Darwin Admits Profound Ignorance.*—Darwin does not pretend to have discovered any law or rule according to which new forms have been born from old forms. He does not hold that outward conditions, however changed, are sufficient to account for them. Still less does he connect them with the effort or aspirations of any organism after new faculties and powers. He frankly confesses that "our ignorance of the laws of variation is profound," and says that in speaking of them as due to chance he means only "to acknowledge plainly our ignorance of the cause of each particular variation." ["Origin of Species," p. 131 (first edition).] Again he says: "I believe in no law of necessary development." [Ibid., p. 351.] This distinction between Mr. Darwin's theory and other theories of development has not, I think, been sufficiently observed. His theory seems to be far better than a mere theory—to be an established scientific truth—in so far as it accounts, in part at least, for the success and establishment and spread of new forms *when they have arisen.* But it does not even suggest the law under which, or by which, or according to which such new forms are introduced.—ARGYLL *Reign of Law*, ch. 5, p. 130. (Burt.)

2489. ———— ———— *Natural Selection Not a Cause.*—It cannot be too often repeated that natural selection can produce nothing whatever, except the conservation or preservation of some variation otherwise originated. The true origin of species does not consist in the adjustments which help varieties to live and to prevail, but in those previous adjustments which cause those varieties to be born at all. Now what are these? Can they be traced or even guessed at? Mr. Darwin has a whole chapter on the "Laws of Variation": and it is here, if anywhere, that we look for any suggestion as to the physical causes which account for the origin as distinguished from the mere preservation of species. He candidly admits that his doctrine of natural selection takes cognizance of variations only after they have arisen, and that it regards those variations as purely accidental in their origin, or, in other words, as due to chance. This, of course, he adds, is a supposition wholly incorrect, and only serves "to indicate plainly our ignorance of the cause of each particular variation."—ARGYLL *Reign of Law*, ch. 5, p. 143. (Burt.)

2490. ORIGIN, SUPPOSED INDEPENDENT, OF SIMILAR STRUCTURES—Nor is it clear that the apes of the New World and those of the Old ever had any ape ancestors common to both. Possibly further discoveries in the Eocene deposits of North America (which are such veritable treasure-houses of relics of ancient life) will reveal to us the past existence of transitional forms between the monkeys of America and of Asia and Africa; but, in spite of all that has been published, this has not, to our minds, been done, and we think it quite possible that these two families have had different origins, and have come to resemble each other independently.—MIVART *Types of Animal Life*, ch. 1, p. 34. (L. B. & Co., 1893.)

2491. ORIGINATORS AND FOLLOWERS—*Brutes Not Inventive.*—Reflect a moment upon your own daily life and you will recognize two sets of activity, those which you originate, and those in which you follow suit. Animals can learn to follow suit, and to a very limited extent can originate. But it is the divine spark of originality which underlies every thought or device in this world. As one man invents a machine and others by thousands fall into the use of it, as the musician composes a song and millions sing it, so was it in the cradle-land of humanity: the inventor, touched with fire from the divine altar, set new examples to be followed.—MASON *The Birth of Invention (Address at Centenary of American Patent System, Washington, D. C., 1891, Proceedings of the Congress,* p. 407).

2492. OSTRICH OF AMERICA—*The "Ship of the Wilderness"—Invisible by Protective Coloring.*—Among the feathered inhabitants of the pampas the grand archaic ostrich of America survives. . . .

The rhea possesses a unique habit, which is a puzzle to us, altho it probably once had some significance—namely, that of running, when hunted, with one wing raised vertically, like a great sail—a veritable " ship of the wilderness." In every way it is adapted to the conditions of the pampas. . . . Its commanding stature gives it a wide horizon; and its dim, pale, bluish-gray color assimilates to that of the haze, and renders it invisible at even a moderate distance. Its large form fades out of sight mysteriously, and the hunter strains his eyes in vain to distinguish it on the blue expanse. Its figure and carriage have a quaint majestic grace, somewhat unavian in character, and peculiar to itself. There are few more strangely fascinating sights in Nature than that of the old black-necked cock-bird, standing with raised agitated wings among the tall plumed grasses, and calling together his scattered hens with hollow boomings and long mysterious suspirations, as if a wind blowing high up in the void sky had found a voice.—HUDSON *Naturalist in La Plata,* ch. 1, p. 26. (C. & H., 1895.)

2493. OUTCASTS OF HUMANITY—*Evidence of Vanished Civilization—Figures on the Rocks.*—The South-American steppes are the boundaries of a European semi-civilization. To the north, between the mountain chain of Venezuela and the Caribbean Sea, lie, crowded together, industrial cities, clean and neat villages, and carefully tilled fields. Even a taste for arts, scientific culture, and a noble love of civil freedom have long since been awakened within these regions.

To the south, a drear and savage wilderness bounds the steppe. Forests, the growth of thousands of years, in one impenetrable thicket, overspread the marshy region between the rivers Orinoco and Amazon. Huge masses of lead-colored granite contract the beds of the foaming rivers. Mountains and forests reecho with the thunder of rushing waters, the roar of the tiger-like jaguar, and the dull rain-foreboding howl of the bearded ape. . . .

In this grand and wild condition of Nature dwell numerous races of men. Separated by a remarkable diversity of languages, some are nomadic, unacquainted with agriculture, and living on ants, gums, and earth, mere outcasts of humanity, . . . such as the Ottomaks and Jarures; others, for instance the Maquiritares and Macos, have settled habitations, live on fruits cultivated by themselves, are intelligent, and of gentler manners. Extensive tracts between the Cassiquiare and the Atabapo are inhabited solely by the tapir and social apes; not by man. Figures graven on the rocks . . . attest that even these deserts were once the seat of a higher civilization. They bear testimony, as do also the unequally developed and varying languages (which are amongst the oldest and most imperishable of the historical records of man), to the changing destinies of nations.—HUMBOLDT *Views of Nature,* p. 19. (Bell, 1896.)

2494. OUTLOOK ON THE UNIVERSE ENLARGED BY TELESCOPE—*Satellites of Jupiter and Ring of Saturn Discovered.*—The increased power of vision, yielded nearly two hundred and fifty years ago by the invention of the telescope, has afforded to the eye, as the organ of sensuous cosmical contemplation, the noblest of all aids toward a knowledge of the contents of space, and the investigation of the configuration, physical character, and masses of the planets and their satellites. The first telescope was constructed in 1608, seven years after the death of the great observer, Tycho Brahe. Its earliest fruits were the successive discovery of the satellites of Jupiter, the sun's spots, the crescent shape of Venus, the ring of Saturn as a triple planetary formation, . . . telescopic stellar swarms, and the nebulæ in Andromeda. In 1634, the French astronomer Morin, eminent for his observations on longitude, first conceived the idea of mounting a telescope on the index-bar of an instrument of measurement, and seeking to discover Arcturus by day. The perfection in the graduation of the arc would have failed entirely, or to a considerable extent, in affording that greater precision of observation at which it aimed, if optical and astronomical instruments had not been brought into accord, and the correctness of vision made to correspond with that of measurement. The micrometer application of fine threads stretched in the focus of the telescope, to which that instrument owes its real and invaluable importance, was first devised six years afterward (1640), by the young and talented Gascoigne.—HUMBOLDT *Cosmos,* vol. iii, p. 41. (H., 1897.)

2495. OWNERSHIP, SENSE OF, ESSENTIAL TO MENTAL HEALTH—The sense of ownership begins in the second year of life. Among the first words which an infant learns to utter are the words "my" and "mine," and woe to the parents of twins who fail to provide their gifts in duplicate. The depth and primitiveness of this instinct would seem to cast a sort of psychological discredit in advance upon all radical forms of communistic utopia. Private proprietorship cannot be practically abolished until human nature is changed. It seems essential to mental health that the individual should have something beyond the bare clothes on his back to which he can assert exclusive possession, and which he may defend adversely against the world.—JAMES *Talks to Teachers*, ch. 7, p. 55. (H. H. & Co., 1900.)

2496. PAIN DUE TO DISCORD OR EXCESS—*Conflict and Violence Distressing.*—Conflict and violence are two principal modes of painful stimulation, and explain a very considerable number of our pains. In most, if not in all, of the painful sensations of three of the senses—namely, touch, hearing, and sight—the pain is either discord or excess. The smarting acuteness of a blow on the skin, of a railway whistle close to the ear, of a glare of light, are due to the mere degree or excess of the stimulus. In hearing and in sight there are, in addition, the pains of discord. In the two remaining senses, taste and smell, we cannot make the same affirmation. We do not know what is the mode of nervous action in a bitter taste, as quinin or soot, and we cannot say that the transition from sweet to bitter is a transition from moderate stimulus to an excessive one. It may be that the power of the nerve is exhausted under a different kind of influence from mere violence of stimulation; but no certain knowledge exists on the subject. The same remarks apply to smell.—BAIN *Mind and Body*, ch. 4, p. 18. (Hum., 1880.)

2497. PAIN LATENT IN JOY—*Suffering and Sacrifice Conditions of the Highest Good—The Mother's Devotion.*—Do we not see that our natural feelings mislead us when they pronounce pleasant things to be the good ones, and the painful ones evil? So far from this being the case, things that we call painful, that are painful in our ordinary state, are essential conditions of our highest good. To us there could not be love without them. We could never have felt the joy, never have had even the idea, of love, if sacrifice had been impossible to us. In our truest and intense happiness that which is otherwise felt as pain is present. Pain, we may say, is latent in our highest state. It lies hidden and unfelt in the form of devoted sacrifice; but it is there, and it would make itself felt as pain if the love which finds joy in bearing it were absent. Take, for example, the offices rendered with joy by a mother to her babe; let the love be wanting, and what remains? Not mere indifference, but vexation, labor, annoyance. A gladly accepted pain is in the mother's love; it is in all love that does not contradict the name. To take away from us the possibility of that which we feel as pain were to take its best part from life, to render it almost—surely altogether—worthless. The possibility of love is given to us in our power of sacrifice, and loving brings the power into immediate action.—HINTON *The Mystery of Pain*, p. 21. (Hum., 1893.)

2498. PAINLESSNESS OF VIOLENT DEATH—*Livingstone and the Lion.*—In all cases in which persons have escaped after being seized by a lion or tiger they declare that they suffered little or no pain, physical or mental. A well-known instance is that of Livingstone, who thus describes his sensations when seized by a lion: "Starting and looking half round, I saw the lion just in the act of springing on me. I was upon a little height; he caught my shoulder as he sprang, and we both came to the ground below together. Growling horribly close to my ear, he shook me as a terrier dog does a rat. The shock produced a stupor similar to that which seems to be felt by a mouse after the first shake of the cat. It causes a sort of dreaminess, in which there was no sense of pain or feeling of terror, tho I was quite conscious of all that was happening. It was like what patients partially under the influence of chloroform describe, who see all the operation, but feel not the knife. This singular condition was not the result of any mental process. The shake annihilated fear, and allowed no sense of horror in looking round at the beast."—WALLACE *Darwinism*, ch. 2, p. 25. (Hum.)

2499. PAINTING, EGYPTIAN, CONVENTIONAL FETTERS OF—*Greek Pictures Excel in Freedom and Naturalness.*—In color-drawing or painting the Egyptian wall-paintings show a style half-way between the lowest and the highest. Here the scenes of old Egyptian life are caught at their characteristic moments, the shoemaker is seen drawing his thread, the fowler throwing at the ducks, the lords and ladies feasting, and the flute-players and tumblers performing before them. Yet with all their clever expressiveness, the Egyptian paintings have not quite left behind the savage stage of art. In fact, they are still picture-writings rather than pictures, repeating rows of figures with heads, legs, and arms drawn to pattern, and colored in childish daubs of color—hair all black, skin all red-brown, clothing white, and so on. The change from these to the Greek paintings is surprising; now we have no more rows of man-patterns, but grouped studies of real men. The best works of the Greek painters are only known to moderns by the admiring descriptions of the ancients, but more ordinary specimens

which have been preserved give an idea what the paintings of Zeuxis and Apelles may have been. The tourist visiting for the first time the museum of Naples comes with a shock of surprise in face of Alexander of Athens' picture of the goddesses at play, the boldly drawn frescos of scenes from the "Iliad," and the groups of dancers elegant in drawing and coloring. Most of these pictures from Herculaneum and Pompeii were done by mere house decorators, but these tenth-rate Greek painters had the traditions of the great classic school, and they show plainly that from the same source we also have inherited the art of design.—TYLOR *Anthropology*, ch. 12, p. 303. (A., 1899.)

2500. PAIRS, STRANGELY ASSORTED—*Bright Star with Dark Companion—Fitful and Intermittent Light.*—"Eclipse-stars" are actually found in the heavens. The best and longest-known member of the group is Algol in the head of Medusa, the "Demon-star" of the Arabs. This remarkable object, normally of the second magnitude, loses and regains three-fifths of its light once in 68.8 hours, the change being completed in about ten hours. Its definite and limited nature and punctual recurrence suggested to Goodricke of York, by whom the periodicity of the star was discovered in 1783, the interposition of a large, dark satellite. But the conditions involved by the explanation were first seriously investigated by Pickering in 1880. He found that the phenomena could be satisfactorily accounted for by supposing an obscure body 0.764 of the bright star's diameter to revolve round it in a period identical with that of its observed variation. This theoretical forecast was verified with singular exactitude at Potsdam in 1889.—CLERKE *History of Astronomy*, pt. ii, ch. 12, p. 469. (Bl., 1893.)

2501. PARABLE A NECESSITY—*Truth Veiled, Not Dismembered.*—Edward Irving [says]: "We must speak in parables, or we must present a wry and deceptive form of truth, of which choice the first is to be preferred, and our Lord adopted it. Because parable is truth veiled, not truth dismembered; and as the eye of the understanding grows more piercing, the veil is seen through, and the truth stands revealed." Nature is the great parable, and the truths which she holds within her are veiled, but not dismembered. The pretended separation between that which lies within Nature and that which lies beyond Nature is a dismemberment of the truth. Let both those who find it difficult to believe in anything which is "above" the natural, and those who insist on that belief, first determine how far the natural extends. Perhaps in going round these marches they will find themselves meeting upon common ground. For, indeed, long before we have searched out all that the natural includes, there will remain little in the so-called supernatural which can seem hard of acceptance or belief—nothing which is not rather essential to our understanding of this otherwise "unintelligible world."—ARGYLL *Reign of Law*, ch. 1, p. 32. (Burt.)

2502. PARADOX OF NATURE—*Glacier Preserved under Lava-stream.*—A remarkable discovery was made on Etna in 1828 of a great mass of ice, preserved for many years, perhaps for centuries, from melting, by the singular accident of a current of red-hot lava having flowed over it. The following are the facts in attestation of a phenomenon which must at first sight appear of so paradoxical a character. The extraordinary heat experienced in the south of Europe during the summer and autumn of 1828 caused the supplies of snow and ice which had been preserved in the spring of that year for the use of Catania . . . to fail entirely. . . . The magistrates of Catania applied to Signor M. Gemmellaro, in the hope that his local knowledge of Etna might enable him to point out some crevice or natural grotto on the mountain where drift-snow was still preserved. Nor were they disappointed; for he had long suspected that a small mass of perennial ice at the foot of the highest cone was part of a large and continuous glacier covered by a lava current. Having procured a large body of workmen, he quarried into this ice, and proved the superposition of the lava for several hundred yards, so as completely to satisfy himself that nothing but the subsequent flowing of the lava over the ice could account for the position of the glacier. . . . We may suppose that at the commencement of the eruption a deep mass of drift-snow had been covered by volcanic sand showered down upon it before the descent of the lava. A dense stratum of this fine dust mixed with scoriæ is well known to be an extremely bad conductor of heat; and the shepherds in the higher regions of Etna are accustomed to provide water for their flocks during summer, by strewing a layer of volcanic sand a few inches thick over the snow, which effectually prevents the heat of the sun from penetrating. Suppose the mass of snow to have been preserved from liquefaction until the lower part of the lava had consolidated, we may then readily conceive that a glacier thus protected, at the height of ten thousand feet above the level of the sea, would endure as long as the snows of Mont Blanc.—LYELL *Geology*, ch. 25, p. 412. (A., 1854.)

2503. PARALLAX OF STARS—*Difficulties that Beset the Problem—Patience and Exactness of Science.*—In the whole of sidereal astronomy there is, perhaps, nothing more difficult to determine than the parallax of a star. To think that among all the stars in the sky there is not one which shows a parallax of one second—that is to say, an annual motion of two seconds! Now, two seconds is a millimeter seen at a hundred meters, it is a hair of a tenth of a millimeter seen at 10 meters

(32.8 feet)! Well, it is in this width that the annual motion of a star is performed. The telescope magnifies it, of course; without this it would be absolutely imperceptible; but how easily it can be concealed by the imperceptible motions of the telescope, by the influences of temperature, by refraction, precession, nutation, aberration, and by the proper motion of the star itself in space! All these united influences amount to several seconds, and are themselves subject to some uncertainties, and instrumental errors must still be added to them. How, then, shall we extricate trustworthy indications of the minute displacement due to the effect of the earth's motion? Astronomers have, however, succeeded in doing so for some stars.—FLAMMARION *Popular Astronomy,* bk. v, ch. 5, p. 596. (A.)

2504. PARASITE, DEFINITION OF—*Food and Shelter at Second Hand.*—In general, we term every living creature a parasite, in the widest sense, that takes shelter and food within a living creature of another sort. The shelter may be temporary or permanent, and the food may either be derived directly from the fluids or the tissues of the host, or from his gains, or even from his secretions or excretions, and offal. The only requisite for being a parasite is that by nature it should be assigned to such a host that it must be unable to maintain existence without such an organism to entertain it, and it is immaterial whether the parasite is inconvenient or not to the host, or whether he causes any visible injury or not, or even whether he may be useful in any respect.—HELLER *Die Schmarotzer, mit besonderer Berücksichtigung der für den Menschen wichtigen,* p. 3. (Translated for *Scientific Side-Lights.*)

2505. PARASITE, INJURY TO SILKWORM FROM—If, in 1870, any one had affirmed that a miserable little insect from across the water were going to cause to France an injury of an importance pecuniarily equal to, in fact even greater than, that incurred by the war indemnity paid to Germany, people would have protested against such a prophecy as pessimistic—altogether nonsensical. Nevertheless, it is true, or at least will come true.—BEAULIEU, quoted, p. 204, in HELLER'S *Die Schmarotzer.* (Translated for *Scientific Side-Lights.*)

2506. PARASITISM A CAUSE OF DEGENERACY—Many groups of animals contain certain genera, families, or even whole orders, which live at the expense of other animals, feeding on their blood or tissues, yet not killing them after the manner of beasts of prey. Such are the parasites, some of which only seek their unwilling host when impelled by hunger, and leave it as soon as they are satisfied, while others take up their abode in or upon it, only to be driven thence by its death. The great group of worms includes very many parasites, and they are almost as numerous among the *Crustacea.* Most crustaceans are free-swimming or actively running inhabitants of the water, especially of the sea, and their food is partly of a vegetable nature and partly consists of living or dead animals; but nearly every order includes some parasitic form, in which the effects of disuse resulting from parasitism are plainly traceable.—WEISMANN *Heredity,* vol. ii, p. 10. (Cl. P., 1892.)

2507. ——— ——— *Inaction Entails Loss of Function—Idleness Ends in Degradation.*—That something of the lower nature often commingles with higher things is, unfortunately, a fact of life that needs no new illustration. Mistletoe is a "parasite" on apple and oak, and parasites belong to the groundlings among life's children. There is no nobility in the character of animal or plant which attaches itself to another living being, either as a lodger or a boarder, or in the double capacity of an unbidden guest. Plant morals, like animal morals, are often of the grossly utilitarian type. If a living being is cunning enough to take life easy by absorbing the food which another child of life prepares for its own use, the parasite doubtless benefits by its assumption of the rôle of unwelcome guest. . . . But there is a stern decree of that implacable female, Madre Natura, which declares that parasitism includes the lowering of the form which sacrifices its vital independence to luxurious comfort and inglorious ease. In animals, legs, stomachs, eyes, and other belongings are swept away when the parasite, attaching itself to another animal, is found to have no use for the organs of free and normal existence. This is the penalty of parasitism everywhere—degradation and backsliding in the vital scale.—ANDREW WILSON *Glimpses of Nature,* ch. 21, p. 69. (Hum., 1892.)

2508. PARSIMONY IN CONSCIOUSNESS—*Perceptions Needless to Notice Become Unconscious—The Goal Becomes All.*—It is a general principle in psychology that consciousness deserts all processes where it can no longer be of use. The tendency of consciousness to a minimum of complication is in fact a dominating law. The law of parsimony in logic is only its best known case. We grow unconscious of every feeling which is useless as a sign to lead us to our end. . . . So in acquiring any art or voluntary function. The marksman ends by thinking only of the exact position of the goal, the singer only of the perfect sound, the balancer only of the point of the pole whose oscillations he must counteract. The associated mechanism has become so perfect in all these persons that each variation in the thought of the end is functionally correlated with the one movement fitted to bring the latter about. Whilst they were tyros they thought of their means as well as their end: the marksman of the position of his

gun or bow or the weight of his stone; the pianist of the visible position of the note on the keyboard; the singer of his throat or breathing; the balancer of his feet on the rope, or his hand or chin under the pole. But little by little they succeeded in dropping all this supernumerary consciousness, and they became secure in their movements exactly in proportion as they did so.—JAMES *Psychology*, vol. ii, ch. 26, p. 496. (H. H. & Co., 1899.)

2509. PARTHENOGENESIS, NATURE FURNISHES INSTANCES OF—*Successive Generations of a Single Sex.*—One of the most remarkable deviations from the normal law of development is seen in the case of the little aphides, or plant-lice, the insects so familiar to all as the pests of the gardener. At the close of the autumn season winged males and females of these insects appear amongst their neighbor-aphides, and these produce eggs, which, however, lie dormant throughout the winter. Waking into life and development with the returning spring, these eggs give birth each to a wingless female, no insect of the sterner sex being found amongst the developed progeny of these insects. The presence of both sexes is throughout the animal world regarded as necessary for the production of eggs capable of developing into offspring. Strangely enough, however, these wingless females not only produce eggs, hatching them within their bodies, but the eggs develop into beings exactly resembling themselves, not a single male aphis being represented within the limits of this amazonian population. Seven, eight, nine, or even eleven generations of these wingless females may be produced in this manner, and the swarms of plant-lice which infest our vegetation attest the fertility of the race. But in the last brood of these insects, produced toward the close of autumn, winged males appear in addition to the females, which latter also possess wings. The members of this last brood produce eggs of ordinary nature, which lie dormant during the winter, but which in the succeeding spring will inaugurate the same strange life history through which their progenitors passed. . . . The law of heredity appears to operate in this instance in a somewhat abnormal, or at any rate in a very unusual manner. The true similitude of the winged parents is not attained until after the lapse of months, and through the interference, as it were, of many generations of dissimilar individuals.—ANDREW WILSON *The Law of Likeness*, p. 37. (Hum., 1888.)

2510. PARTICLES SMALLER THAN LIGHT-WAVES—*Microscope Does Not Reveal Them.*—Our best microscopes can readily reveal objects not more than $\frac{1}{50000}$ of an inch in diameter. This is less than the length of a wave of red light. Indeed, a first-rate microscope would enable us to discern objects not exceeding in diameter the length of the smallest waves of the visible spectrum. By the microscope, therefore, we can test our particles. If they be as large as the light-waves they will infallibly be seen; and if they be not so seen, it is because they are smaller. Some months ago I placed in the hands of our president a liquid containing Brücke's precipitate [of resin from alcoholic solution let fall in water]. The liquid was milky blue, and Mr. Huxley applied to it his highest microscopic power. He satisfied me that had particles of even $\frac{1}{100000}$ of an inch in diameter existed in the liquid they could not have escaped detection. But no particles were seen. Under the microscope the turbid liquid was not to be distinguished from distilled water.—TYNDALL *Fragments of Science*, vol. ii, ch. 8, p. 119. (A., 1897.)

2511. PARTICLES, SUPPOSED, OF LIGHT—*Newton's "Emission Theory"—Mistaken Analogy of Gravitation.*—Newton's conceptions regarding the nature of light were influenced by his previous knowledge. He had been pondering over the phenomena of gravitation, and had made himself at home amid the operations of this universal power. Perhaps his mind at this time was too freshly and too deeply imbued with these notions to permit of his forming an unfettered judgment regarding the nature of light. Be that as it may, Newton saw in refraction the action of an attractive force exerted on the light-particles. He carried his conception out with the most severe consistency. Dropping vertically downwards towards the earth's surface, the motion of a body is accelerated as it approaches the earth. Dropping in the same manner downwards on a horizontal surface, say through air on glass or water, the velocity of the light-particles, when they came close to the surface, was, according to Newton, also accelerated. Approaching such a surface obliquely, he supposed the particles, when close to it, to be drawn down upon it, as a projectile is drawn by gravity to the surface of the earth. This deflection was, according to Newton, . . . refraction. . . . Finally, it was supposed that differences of color might be due to differences in the size of the particles. This was the physical theory of light enunciated and defended by Newton; and you will observe that it simply consists in the transference of conceptions born in the world of the senses to a subsensible world.—TYNDALL *Lectures on Light*, lect. 2, p. 46. (A., 1898.)

2512. PARTICLES, VIEWLESS, OF ODOR—*Rotary Motion of Odorous Substances.*—Since the interesting discovery of Romieu, in 1756, that very small bits of camphor on the surface of water have a curious rotary motion, the same phenomenon has been noticed by a number of observers in several hundred odorous substances of either vegetable or animal structure. This, of course, strengthens the belief that the stimulus of

smell is thrown off from these substances in the form of invisible and imponderable particles. If paper be tied in front of the nostrils of dogs, they cannot "track" game or follow their masters by the sense of smell.—LADD *Psychology*, ch. 6, p. 100. (S., 1899.)

2513. PARTNERSHIP OF HEAT AND COLD—*Each in Turn Contributes to Purity of Milk.*—While the heating process is of course the essential feature of efficient pasteurization, it must not be forgotten that rapid and thorough cooling is almost equally important. . . . Pasteurization differs from complete sterilization in that it leaves behind a certain number of microbes or their spores. Cooling inhibits the germination and growth of this organismal residue. If after the heating process the milk is cooled and kept in a refrigerator, it will probably keep sweet from three to six days, and may do so for three weeks.—NEWMAN *Bacteria*, ch. 6, p. 211. (G. P. P., 1899.)

2514. PARTNERSHIPS IN THE VEGETABLE KINGDOM—*Combination for Mutual Advantage Not Parasitism.*—Bacterial life in several ways is able to reclaim from the atmosphere this free nitrogen, which would otherwise be lost. The first method to which reference may be made is that involving symbiosis. This term signifies "a living together" of two different forms of life, generally for a specific purpose. It may be to mutual advantage, a living for one another, or it may be, by means of an interchange of metabolism or products, finally to produce or obtain some remote chemical result. . . . The partnerships between hermit crabs and sea-anemones and the like are sometimes defined by the term commensalism (joint diet). Symbiosis and commensalism must be distinguished from parasitism, which indicates that all the advantage is on the side of the parasite, and nothing but loss on the side of the host. The distinction between symbiosis and commensalism cannot be rigid, but between these conditions, which are advantageous to the partners, and parasitism, there is an obvious and radical difference. The example of bacteriological symbiosis, with which we are concerned here, is that partnership between bacteria and some of the higher plants *(Leguminosæ)* for the purpose of fixing nitrogen in the plant and in the surrounding soil.—NEWMAN *Bacteria*, ch. 5, p. 162. (G. P. P., 1899.)

2515. PASSAGE FROM ONE KINGDOM TO ANOTHER IMPOSSIBLE—*Inorganic Shut from Organic; Natural from Spiritual.*—The passage from the natural world to the spiritual world is hermetically sealed on the natural side. The door from the inorganic to the organic is shut, no mineral can open it; so the door from the natural to the spiritual is shut, and no man can open it. This world of natural men is staked off from the spiritual world by barriers which have never yet been crossed from within. No organic change, no modification of environment, no mental energy, no moral effort, no evolution of character, no progress of civilization can endow any single human soul with the attribute of spiritual life. The spiritual world is guarded from the world next in order beneath it by a law of biogenesis—except a man be born again . . . he cannot enter the Kingdom of God.—DRUMMOND *Natural Law in the Spiritual World*, int., p. 64. (H. Al.)

2516. PASSING OF UNSEEN HOSTS—*The Nocturnal Journeys of Birds.*—This nocturnal journey of birds may also be studied from lighthouses. On September 26, 1891, I visited the Bartholdi Statue of the Goddess of Liberty, in New York Bay, for this purpose. The weather was most favorable. The first bird was observed at eight o'clock, and for the succeeding two hours others were constantly heard, tho comparatively few were seen. At ten o'clock it began to rain; and almost simultaneously there was a marked increase in the number of birds about the light, and within a few minutes there were hundreds where before there was one, while the air was filled with the calls of the passing host. From the balcony which encircles the torch the scene was impressive beyond description. We seemed to have torn aside the veil which shrouds the mysteries of the night, and with the searching light exposed the secrets of Nature. By far the larger number of birds hurried onward; others hovered before us, like humming-birds before a flower, then flew swiftly by into the darkness; and some, apparently blinded by the brilliant rays, struck the statue slightly, or with sufficient force to cause them to fall dead or dying. At daybreak a few stragglers were still winging their way southward, but before the sun rose the flight was over.—CHAPMAN *Bird-Life*, ch. 4, p. 57. (A., 1900.)

2517. PAST A GUIDE FOR FUTURE—*Volcanic Eruptions—Etna.*—However natural it may be that the force of running water in numerous valleys, and of tides and currents in many tracts of the sea, should now be spent, it is by no means so easy to explain why the violence of the earthquake and the fire of the volcano should also have become locally extinct at successive periods. We can look back to the time when the marine strata, whereon the great mass of Etna rests, had no existence; and that time is extremely modern in the earth's history. This alone affords ground for anticipating that the eruptions of Etna will one day cease.

> Nec quæ sulfureis ardet fornacibus Etna
> Ignea semper erit, *neque enim fuit ignea semper.*
> (OVID *Metam.*, lib. 15, l. 340.)
>
> [Nor Ætna, vomiting sulfureus fire,
> Will ever belch; for sulfer will expire
> —*Dryden's Trans.*]

are the memorable words which are put into the mouth of Pythagoras by the Roman poet, and they are followed by speculations as to the cause of volcanic vents shifting their positions. Whatever doubts the philosopher expresses as to the nature of these causes, it is assumed, as incontrovertible, that the points of eruption will hereafter vary, because they have formerly done so; a principle of reasoning which, as I have endeavored to show in former chapters, has been too much set at naught by some of the earlier schools of geology, which refused to conclude that great revolutions in the earth's surface are now in progress, or that they will take place hereafter, because they have often been repeated in former ages.—LYELL *Principles of Geology*, bk. ii, ch. 22, p. 345. (A., 1854.)

2518. PAST INHARMONIOUS WITH PRESENT SEEMS REMOTE—Thus, when we have lost something we cherished dearly, and the recollection of it brings fruitless longing, we instinctively seek to expel the recollection from our minds. The very feeling that what has been can never again be seems to induce this idea of a vast remoteness of the vanished reality. When, moreover, the lost object was fitted to call forth the emotion of reverence, the impulse to magnify the remoteness of the loss may not improbably be reenforced by the circumstance that everything belonging to the distant past is fitted on that account to excite a feeling akin to reverence. So, again, any rupture in our mental development may lead us to exaggerate the distance of some past portion of our experience. When we have broken with our former selves, either in the way of worsening or bettering, we tend to project these further into the past. —SULLY *Illusions*, ch. 10, p. 260. (A., 1897.)

2519. PAST, TRIUMPHS OF EVOLUTION IN THE—*Nature Always Succeeds—The Pledge of What Is To Be.*—All the other kingdoms of Nature culminated; evolution always attains; always rounds off its work. It spent an eternity over the earth, but finished it. It struggled for millenniums to bring the vegetable kingdom up to the flowering plants, and succeeded. In the animal kingdom it never paused until the possibilities of organization were exhausted in the mammalia. Kindled by this past, man may surely say, "I shall arrive." The further evolution must go on, the higher kingdom come—first the blade, where we are today; then the ear, where we shall be tomorrow; then the full corn in the ear, which awaits our children's children, and which we live to hasten.—DRUMMOND *Ascent of Man*, ch. 10, p. 346. (J. P., 1900.)

2520. PATH OF AMAZON SCOOPED FROM A VAST PLAIN—*Hills Mark Ancient Level.*—It is delightful to Mr. Agassiz, in returning to this locality, to find that phenomena, which were a blank to him on our voyage up the river, are perfectly explicable now that he has had an opportunity of studying the geology of the Amazonian Valley. When we passed these singular flat-topped hills before, he had no clue to their structure or their age, whether granite, as they have been said to be, or sandstone or limestone; whether primitive, secondary, or tertiary: and their strange form made the problem still more difficult. Now he sees them simply as the remnants of a plain which once filled the whole valley of the Amazons, from the Andes to the Atlantic, from Guiana to Central Brazil. Denudations on a colossal scale, hitherto unknown to geologists, have turned this plain into a labyrinth of noble rivers, leaving only here and there, where the formation has resisted the rush of waters, low mountains and chains of hills to tell what was its thickness.—AGASSIZ *Journey in Brazil*, ch. 12, p. 374. (H. M. & Co., 1896.)

2521. PATHWAYS FOR LIGHT THROUGH SOLIDS—*Magnetism Opens a Way.* —To the ether the glass is like a sieve, and so is any substance. Light-waves fly in straight lines. The openings through the glass are probably straight, so the light can pass directly through, but the openings through an opaque body are crooked; the molecules overlap in such a way that there is no direct line through the substance, hence the light will either be absorbed or reflected when it strikes upon an opaque body.

Some idea of what we mean by the overlapping of molecules may be had by the following experiment. Fill a tube with finely pulverized iron filings made into a thin paste. Let the two ends of the tube be stopped with glass heads. Throw a strong beam of light on one end so that the direction of the beam will be in the direction of the length of the tube. Place the tube into a helix (a coil of wire), and pass a current of electricity through the wire of the helix. Now so direct the arrangement that the beam of light strikes upon a screen, and a spot of light will appear on the screen as long as the current is passing; when the current is broken, the spot of light will disappear. The magnetism rearranges the particles of the naturally opaque mass of iron filings so that light can pass between them; they are transparent. When the current is taken off, the magnetism disappears, and the particles arrange themselves again in such a way as to shut off the light. The body becomes opaque.—ELISHA GRAY *Nature's Miracles*, vol. ii, ch. 23, p. 191. (F. H. & H., 1900.)

2522. PATIENCE AND EXACTNESS OF SCIENCE—Through the precautions, variations, and repetitions observed and executed with the view of rendering its results secure, the separate vessels employed in this inquiry [as to spontaneous generation] ha-- mounted up in two years to

nearly ten thousand.—TYNDALL *Floating Matter of the Air,* essay 3, p. 318. (A., 1895.)

2523. ——— ——— *Calculation of Time of Halley's Comet.*—Halley calculated, with great pains, that the influence of the planets would delay the next return of the comet, and he predicted it for the end of 1758 or the beginning of 1759. It was necessary, with the improved mathematical formulæ, to calculate exactly the epoch of this return. Clairaut undertook this, and performed in a masterly manner the algebraical part of the problem; but there remained the immense task of calculating the formulæ numerically. Two computers had the courage to do this—the astronomer Lalande and Madame Hortense Lepaute. During six months the two calculators, hardly taking time to eat, put into numbers the algebraical formulæ of Clairaut. Lalande finished the calculation, and found that Saturn would delay its return by 100 days and Jupiter by 518 days, in all 618 days' delay—that is to say, that its revolution would be a year and eight months longer than its previous revolution; and that, in fact, its perihelion passage would take place within a month of the middle of April, 1759.

Never did scientific prediction excite more lively curiosity from one end of Europe to the other. *The comet reappeared;* it traversed the course announced among the constellations; it passed its perihelion on March 12, 1759, just a month before the day indicated. "We have all observed it," wrote Lalande, "so that it is beyond doubt that comets are truly planets which revolve, like the others, round the sun." Halley's comet, in fulfilling the prediction of the astronomers, opened a new era in cometary astronomy.—FLAMMARION *Popular Astronomy,* bk. v, ch. 1, p. 486. (A.)

2524. ——— ——— *Identification of the Metals of the Sun.*—There have been identified, line for line, in the sun the 460 lines of the spectrum of iron, the 118 of titanium, 75 of calcium, 57 of manganese, 33 of nickel, etc., so that we now know certainly that there are at the surface of that dazzling star, and in the gaseous state, iron, titanium, calcium, manganese, nickel, cobalt, chromium, sodium, barium, magnesium, copper, potassium; but we still cannot recognize any trace of gold, silver, antimony, arsenic, or mercury. Hydrogen was discovered in 1868. Oxygen must exist in this furnace, but the oxygen lines which have been found in the solar spectrum proceed from our own atmosphere (Janssen, 1888).—FLAMMARION *Popular Astronomy,* bk. iii, ch. 7, p. 326. (A.)

2525. ——— ——— *Minute Adjustments—Delicacy of Eye and Hand.*—Nine years later Dr. Henry Draper, of New York, got an impression of four lines in the spectrum of Vega. Then Dr. Huggins attacked the subject again in 1876, when the 18-inch speculum of the Royal Society had come into his possession, using prisms of Iceland spar and lenses of quartz, and this time with better success. A photograph of the spectrum of Vega showed seven strong lines. Still he was not satisfied. He waited and worked for three years longer. At length, on December 18, 1879, he was able to communicate with the Royal Society results answering to his expectations. The delicacy of eye and hand needed to attain them may be estimated from the single fact that the image of a star had to be kept, by continual minute adjustments, exactly projected upon a slit $\frac{1}{250}$ of an inch in width during nearly an hour, in order to give it time to imprint the characters of its analyzed light upon a gelatin plate raised to the highest pitch of sensitiveness.—CLERKE *History of Astronomy,* pt. ii, ch. 12, p. 462. (Bl., 1893.)

2526. ——— ——— *Tracing Gradations of Species.*—For five consecutive years I have investigated this small but highly instructive group of animals [the calcareous sponges] in all its forms in the most careful manner. . . . With a view to these facts, I made two journeys to the seacoast (1869 to Norway, 1871 to Dalmatia), in order to study as large a number of individuals as possible in their natural circumstances, and to collect specimens for comparison. Of many species I compared several hundred individuals in the most careful way. I examined with the microscope and measured in the most accurate manner the details of form of all the species. As the final result of these exhaustive and almost endless examinations and measurements it appeared that "good species," in the ordinary dogmatic sense of the systematists, have no existence at all among the calcareous sponges; that the most different forms are connected one with another by numberless gradational transition forms; and that all the different species of calcareous sponges are derived from a single exceedingly simple ancestral form, the olynthus.—HAECKEL *History of Creation,* vol. i, pref., p. 17. (K. P. & Co., 1899.)

2527. PATIENCE OF ASTRONOMER—*Vast Endeavor for Limited Result—Five Minutes' Observation the Reward of a Day's Watching.*—The surface of the sun may be compared to an elaborate engraving, filled with the closest and most delicate lines and hatchings, but an engraving which during ninety-nine hundredths of the time can only be seen across such a quivering mass of heated air as makes everything confused and liable to be mistaken, causing what is definite to look like a vaguely seen mottling. It is literally true that the more delicate features . . . are only distinctly visible even by the best telescope during less than one-hundredth of the time, coming out as they do in brief instants when our dancing air is momentarily still, so that one who has

sat at a powerful telescope all day is exceptionally lucky if he has secured enough glimpses of the true structure to aggregate five minutes of clear seeing, while at all other times the attempt to magnify only produces a blurring of the image. This study, then, demands not only fine telescopes and special optical aids, but endless patience.—LANGLEY *New Astronomy,* ch. 1, p. 17. (H. M. & Co., 1896.)

2528. PEACE, WOMAN'S INFLUENCE FOR—A charming confession is made by [E. H. Man] with reference to the moral influence of woman's presence. He says: "Experience has taught us that one of the most effective means of inspiring confidence when endeavoring to make acquaintance with these savages is to show that we are accompanied by women, as they at once infer that, whatever may be our intentions, they are at least not hostile."—MASON *Woman's Share in Primitive Culture,* int., p. 7. (A., 1894.)

2529. PEAKS, VOLCANIC, THE WORK OF TIME—*The Slow Building of Mountains.*—All volcanic mountains are nothing but heaps of materials ejected from fissures in the earth's crust, the smaller ones having been formed during a single volcanic outburst, the larger ones being the result of repeated eruptions from the same orifice, which may, in some cases, have continued in action for tens or hundreds of thousands of years.—JUDD *Volcanoes,* ch. 4, p. 75. (A., 1899.)

2530. PECULIARITIES OF GEOGRAPHIC DISTRIBUTION—*Humming-birds Confined to the American Continent.*—We come on the curious facts of geographical distribution, a class of facts which, as much as any other, suggest some specific methods as having been followed in the work of creation. Humming-birds are absolutely confined to the great continent of America, with its adjacent islands. Within those limits there is every range of climate, and there are particular species of humming-bird adapted to every region where a flowering vegetation can subsist. It is therefore neither climate nor food which confines the humming-birds to the New World. What is it, then? The idea of "centers of creation" is at once suggested to the mind. It seems as if the humming-birds were introduced at one spot, and as if they had spread over the whole continent which was accessible to them from that spot. They are absent elsewhere, simply because from that spot the other continents of the world were inaccessible to them.—ARGYLL *Reign of Law,* ch. 5, p. 133. (Burt.)

2531. PENALTY OF DISUSE—*Eyes of Cave-fish Atrophied.*—For instance, if a species which had always lived in the light were to find its way into some new habitat where there was complete darkness, its eyes would become useless to it; and accordingly we commonly find that in such species the eyes have more or less completely atrophied.

This is the case, for instance, with animals which live in dark caves. . . . In the Mammoth Cave of Kentucky, among other blind animals we find a blind fish and a blind fresh-water crayfish. It is almost superfluous to offer any further proof that these species are descended from ancestors which possessed the power of sight beyond the fact that the caverns in question have not existed from the beginnings of organic life, and that therefore the animals must have lived in the light before they entered them. Nevertheless, in many of these animals direct proof exists in the fact that they still possess vestiges of what have once been eyes. The proteus and the blind fish of the Mammoth Cave have small, imperfectly developed eyes under the skin, which are no longer of any use as organs of sight. In the case of the blind crayfish the eyes have entirely disappeared, altho the movable stalks upon which they were placed still remain.—WEISMANN *Heredity,* vol. ii, ch. 9, p. 9. (Cl. P., 1897.)

2532. PENDULUM TELLS FORM OF EARTH—*Galileo and the Chandeliers.*—Galileo, who first observed when a boy (having, probably, suffered his thoughts to wander from the service) that the height of the vaulted roof of a church might be measured by the time of the vibration of the chandeliers suspended at different altitudes, could hardly have anticipated that the pendulum would one day be carried from pole to pole, in order to determine the form of the earth.—HUMBOLDT *Cosmos,* vol. i, p. 167. (H., 1897.)

2533. PENETRATION AND ACUTENESS OF A GREAT MIND—*Scientific Spirit of Columbus.*—Among the characteristics of Christopher Columbus we must especially notice the penetration and acuteness with which, without intellectual culture, and without any knowledge of physical and natural science, he could seize and combine the phenomena of the external world. On his arrival in a new world and under a new heaven he examined with care the form of continental masses, the physiognomy of vegetation, the habits of animals, and the distribution of heat and the variations in terrestrial magnetism. While the old admiral strove to discover the spices of India, and the rhubarb *(ruibarba),* which had already acquired a great celebrity through the Arabian and Jewish physicians, and through the account of Rubruquis and the Italian travelers, he also examined with the greatest attention the roots, fruits, and leaves of the different plants. . . . In the journal of his voyage and in his reports . . . we find almost all those circumstances touched upon to which scientific enterprise was directed in the latter half of the fifteenth and throughout the

whole of the sixteenth centuries.—HUMBOLDT *Cosmos*, vol. ii, pt. ii, p. 263. (H., 1897.)

2534. PENETRATION OF LIGHT THROUGH WATER—*No Sunlight in Ocean Depths.*—The entire absence of solar light, which constitutes another most important peculiarity in the conditions of deep-sea life, would seem at first sight to be an absolute bar to its maintenance. Experimental evidence has not yet, I believe, been obtained of the direct penetration of the solar rays to more than 100 fathoms; but as I dredged slow-growing red calcareous algæ (true corallines) in the Mediterranean at a depth of 150 fathoms (at or below which Edward Forbes also would seem to have met with them), the actinic, if not the luminous, rays must probably penetrate to that range. Below what Edward Forbes termed the coralline zone it would seem impossible that any other type of vegetable life can be sustained than such as has the capacity of the fungi for growing in the dark, living, like them, upon material supplied by the decomposition of organic compounds. Such lowly plants have been found by Professor P. M. Duncan in corals dredged from more than 1,000 fathoms' depth.—CARPENTER *Nature and Man*, lect. 11, p. 345. (A., 1889.)

2535. PENTATEUCH IN HARMONY WITH ARCHEOLOGY — *Bronze before Iron —Progress from the Ductile to the Stubborn Metal.*—The forms of early weapons indicate that those of iron were copied from bronze, not those of bronze from iron. Hesiod's poems, as well as those of Homer, show that nearly three thousand years ago the value of iron was known and appreciated. It is true that, as we read in Dr. Smith's "Dictionary of Greek and Roman Antiquities," bronze "is represented in the "Iliad" and "Odyssey" as the common material of arms, instruments, and vessels of various sorts; the latter (iron) is mentioned much more rarely." While, however, the above statement is strictly correct, we must remember that among the Greeks the word iron (σίδηρος) was used, even in the time of Homer, as synonymous with a sword, and that steel also appears to have been known to them under the name of ἀδάμας, and perhaps also of κύανος, as early as the time of Hesiod. We may, therefore, consider that the Trojan war took place during the period of transition from the Bronze to the Iron Age.

In the Pentateuch, including Deuteronomy, bronze, or, as it is unfortunately translated, "brass," is mentioned thirty-eight times, and iron only four times.—AVEBURY *Prehistoric Times*, ch. 1, p. 5. (A., 1900.)

2536. "PEPPER-POT" OF TROPICAL AMERICA—*An Invention of Woman.*—The Indian women of Guiana are excellent purveyors. They have but one way of cooking meat or fish, and that is by boiling it down into a sort of thick soup, with peppers and cassareep, or the juice of strained cassava boiled down to a sirup. The cassareep reduces all meat to one common flavor—its own—and has antiseptic qualities which keep meat boiled in it good for a long time. The result is the far-famed pepper-pot, which all settlers in the West Indies have learned to make and to like.—MASON *Woman's Share in Primitive Culture*, ch. 2, p. 38. (A., 1894.)

2537. PERCEPTION INCREASED BY HABITUAL ATTENTION — *Deaf-and-dumb Lip-reading.*—It has long been known that individuals among the deaf and dumb have acquired the power of "lip-reading"; that is, of so interpreting the visible movements of the mouth and lips of a speaker as to apprehend the words he utters, no less accurately than if they were heard. And it has been latterly proposed to make this a matter of systematic instruction, so that every deaf-mute should be enabled to understand what is said, without the aid of the "sign-language" or the "finger-alphabet." It appears, however, that it is not every one who is capable of acquiring this power, and it is still questionable whether it can be even generally attained by any amount of practise. [It has been done on a considerable scale.] But that it should have been even exceptionally acquired shows the extraordinary improvability of the perceptive faculty.—CARPENTER *Mental Physiology*, bk. i, ch. 5, p. 204. (A., 1900.)

2538. PERCEPTION, JUDGMENT, AND PERSEVERANCE NEEDED FOR SUCCESSFUL SELECTION—*Accumulation of Almost Imperceptible Differences.*—When a cross [in breeding] has been made, the closest selection is far more indispensable even than in ordinary cases. If selection consisted merely in separating some very distinct variety and breeding from it, the principle would be so obvious as hardly to be worth notice; but its importance consists in the great effect produced by the accumulation in one direction, during successive generations, of differences absolutely inappreciable by an uneducated eye—differences which I for one have vainly attempted to appreciate. Not one man in a thousand has accuracy of eye and judgment sufficient to become an eminent breeder. If gifted with these qualities, and he studies his subject for years, and devotes his lifetime to it with indomitable perseverance, he will succeed, and may make great improvements; if he wants any of these qualities, he will assuredly fail. Few would readily believe in the natural capacity and years of practise requisite to become even a skilful pigeon-fancier.—DARWIN *Origin of Species*, ch. 1, p. 27. (Burt.)

2539. PERCEPTION LARGELY PSYCHIC—*We See What We Know or Believe To Be.*—The grass out of the window now looks to me of the same green in the sun as in the shade, and yet a painter would have to

paint one part of it dark brown, another part bright yellow, to give its real sensational effect. We take no heed, as a rule, of the different way in which the same things look and sound and smell at different distances and under different circumstances. The sameness of the things is what we are concerned to ascertain, and any sensations that assure us of that will probably be considered, in a rough way, to be the same with each other.—JAMES *Psychology*, vol. i, ch. 9, p. 231. (H. H. & Co., 1899.)

2540. PERCEPTION OF COLORS LIMITED—*Chemical or Ultraviolet Waves Invisible.*—The first question that we have to consider to-night is this: Is the eye, as an organ of vision, commensurate with the whole range of solar radiation—is it capable of receiving visual impressions from all the rays emitted by the sun? The answer is negative. If we allowed ourselves to accept for a moment that notion of gradual growth, amelioration, and ascension implied by the term "evolution," we might fairly conclude that there are stores of visual impressions awaiting man, far greater than those now in his possession. Ritter discovered in 1801 that beyond the extreme violet of the spectrum there is a vast efflux of rays which are totally useless as regards our present powers of vision. These ultraviolet waves, however, tho incompetent to awaken the optic nerve, can shake asunder the molecules of certain compound substances on which they impinge, thus producing chemical decomposition.—TYNDALL *Lectures on Light*, lect. 5, p. 162. (A., 1898.)

2541. PERCEPTION OF LIGHT IN PAINTING ILLUSIVE—*Relative Judgment of Light and Shade Determines Mental Effect.*—It is found that the degree of luminosity or brightness of a pictorial representation differs in general enormously from that of the actual objects. Thus, according to the calculations of Helmholtz, a picture representing a Bedouin's white raiment in blinding sunshine will, when seen in a fairly lit gallery, have a degree of luminosity reaching only to about one-thirtieth of that of the actual object. On the other hand, a painting representing marble ruins illuminated by moonlight will, under the same conditions of illumination, have a luminosity amounting to as much as from ten to twenty thousand times that of the object. Yet the spectator does not notice these stupendous discrepancies. The representation, in spite of its vast difference, at once carries the mind on to the actuality, and the spectator may even appear to himself, in moments of complete absorption, to be looking at the actual scene.—SULLY *Illusions*, ch. 5, p. 88. (A., 1897.)

2542. PERCEPTION OF TIME AND SPACE DISTURBED BY HASHISH—*Minutes Seem Hours—Distance Seems Interminable.*—The disturbance of the perceptive faculties [by hashish] is remarkably shown in regard to time and space. Minutes seem hours, and hours are prolonged into years; and at last all idea of time seems obliterated, and the past and present are confounded together. M. Moreau mentions as an illustration that on one evening he was traversing the passage of the opera when under the influence of a moderate dose of hashish: he had made but a few steps, when it seemed to him as if he had been there two or three hours; and, as he advanced, the passage appeared to him interminable, its extremity receding as he pressed forwards. But he gives another more remarkable instance. In walking along the boulevards, he has frequently seen persons and things at a certain distance presenting the same aspect as if he had viewed them through the large end of an opera-glass; that is, diminished in apparent size, and therefore suggesting the idea of increased distance. This erroneous perception of space is one of the effects of the *Amanita muscaria*, an intoxicating fungus used by the Tatars; a person under its influence being said to take a jump or a stride sufficient to clear the trunk of a tree, when he wishes only to step over a straw or a small stick. Such erroneous perceptions are common enough among lunatics, and become the foundations of fixed illusions; whilst in the person intoxicated by hashish there is still a certain consciousness of their deceptive character.—CARPENTER *Mental Physiology*, bk. ii, ch. 17, p. 642. (A., 1900.)

2543. PERCEPTION, POWER OF, AMONG SAVAGES—*Arab Knows Footprint of His Own Camels.*—In reading almost any account of savages it is impossible not to admire the skill with which they use their weapons and implements, their ingenuity in hunting and fishing, and their close and accurate powers of observation. Some savages even recognize individuals by their footsteps. Thus Mr. Laing mentions that one day while traveling near Moreton Bay, in Australia, he pointed to a footstep and asked whose it was. The guide "glanced at it without stopping his horse and at once answered, 'White fellow call him Tiger.'" This turned out to be correct, which was the more remarkable as the two men belonged to different tribes, and had not met for two years. Among the Arabs, Burckhardt asserts that some men know every individual in the tribe by his footstep. "Besides this, every Arab knows the printed footsteps of his own camels and of those belonging to his immediate neighbors. He knows by the depth or slightness of the impression whether a camel was pasturing and therefore not carrying any load, or mounted by one person only, or heavily loaded."—AVEBURY *Prehistoric Times*, ch. 15, p. 519. (A., 1900.)

2544. PERCEPTION RELATIVE—*Light and Dark Determined by Contrast.*—What appeals to our attention far more

than the absolute quality or quantity of a given sensation is its ratio to whatever other sensations we may have at the same time. When everything is dark, a somewhat less dark sensation makes us see an object white. Helmholtz calculates that the white marble painted in a picture representing an architectural view by moonlight is, when seen by daylight, from ten to twenty thousand times brighter than the real moonlit marble would be.—JAMES *Psychology*, vol. i, ch. 9, p. 231. (H. H. & Co., 1899.)

2545. PERFECTION, MATHEMATICAL, OF HONEY-BEE'S CELL—[As stated by Dr. Reid] there are only three possible figures of the cells which can make them all equal and similar, without any useless interstices. These are the equilateral triangle, the square, and the regular hexagon. Mathematicians know that there is not a fourth way possible in which a plane may be cut into little spaces that shall be equal, similar, and regular, without useless spaces. Of the three figures, the hexagon is the most proper for convenience and strength. Bees, as if they knew this, make their cells regular hexagons.

Again, it has been demonstrated that, by making the bottoms of the cells to consist of three planes meeting in a point, there is a saving of material and labor in no way inconsiderable. The bees, as if acquainted with these principles of solid geometry, follow them most accurately. It is a curious mathematical problem, at what precise angle the three planes which compose the bottom of a cell ought to meet, in order to make the greatest possible saving or the least expense of material and labor. This is one of the problems which belong to the higher parts of mathematics. It has accordingly been resolved by some mathematicians, particularly by the ingenious Maclaurin, by a fluctionary calculation, which is to be found in the *Transactions* of the Royal Society of London. He has determined precisely the angle required, and he found, by the most exact mensuration the subject would admit, that it is the very angle in which the three planes in the bottom of the cell of a honeycomb do actually meet.—ROMANES *Animal Intelligence*, ch. 4, p. 171. (A., 1899.)

2546. PERFECTION, MECHANICAL, OF INSECT'S WORK—*Larva Spinning Its Shroud.*—For some time Mr. Agassiz has been trying to get living specimens of the insect so injurious to the coffee-tree, the larva of a little moth akin to those which destroy the vineyards in Europe. Yesterday he succeeded in obtaining some, and among them one just spinning his cocoon on the leaf. We watched him for a long time with the lens as he wove his filmy tent. He had arched the threads upwards in the center, so as to leave a little hollow space into which he could withdraw; this tiny vault seemed to be completed at the moment we saw him, and he was drawing threads forward and fastening them at a short distance beyond, thus lashing his house to the leaf, as it were. The exquisite accuracy of the work was amazing. He was spinning the thread with his mouth, and with every new stitch he turned his body backward, attached his thread to the same spot, then drew it forward and fastened it exactly on a line with the last, with a precision and rapidity that machinery could hardly imitate.—AGASSIZ *Journey in Brazil (extract from Journal of Mrs. Agassiz)*, ch. 3, p. 117. (H. M. & Co., 1896.)

2547. PERFECTION OF APPARATUS, IMPORTANCE OF—*Velocity of Light—Error as to Sun's Distance Vitiated Early Measurements—A Terrestrial Distance, That Can Be Surely Measured, Now Made the Basis of Calculation.*—Fizeau, and quite recently Cornu, employing not planetary or stellar distances, but simply the breadth of the city of Paris, determined the velocity of light: while Foucault—a man of the rarest mechanical genius—solved the problem without quitting his private room. Owing to an error in the determination of the earth's distance from the sun, the velocity [192,500 miles per second] assigned to light by both Römer and Bradley is too great. With a close approximation to accuracy it may be regarded as 186,000 miles a second. [From a discussion of all observations in 1891, Professor Harkness found 186,337 $\pm$ 49.722 miles (J. E. Gore, in Flammarion's "Popular Astronomy," p. 318). Flammarion takes 300,000 kilometers, or 186,414 miles, as an accurate statement "in round numbers."]—TYNDALL *Lectures on Light*, lect. 1, p. 23. (A., 1898.)

2548. PERFECTION OF EARLY INSTINCT—*Common Spiders.*—Mr. Blackwall, speaking of British spiders, says: "Complicated as the processes are by which these symmetrical nets are produced, nevertheless young spiders, acting under the influence of instinctive impulse, display, even in their first attempts to fabricate them, as consummate skill as the most experienced individuals."—ROMANES *Animal Intelligence*, ch. 6, p. 216. (A., 1899.)

2549. ——— ——— *Trap-door Spiders.*—Speaking of trap-door spiders, Moggridge says:

"I cannot help thinking that these very small nests, built as they are by minute spiders probably not very long hatched from the egg, must rank among the most marvelous structures of this kind with which we are acquainted. That so young and weak a creature should be able to excavate a tube in the earth many times its own length, and know how to make a perfect miniature of the nest of its parents, seems to be a fact which has scarcely a parallel in Nature."—ROMANES *Animal Intelligence*, ch. 6, p. 217. (A., 1899.)

2550. ——— ——— *Veteran Hunter Foiled by Newly Hatched Bird.*—On a secluded lake in one of the Hebrides I observed a dun diver, or female of the red-breasted merganser *(Mergus serrator)*, with her brood of young ducklings. On giving chase in the boat, we soon found that the young, altho not above a fortnight old, had such extraordinary powers of swimming and diving that it was almost impossible to capture them. The distance they went under water, and the unexpected places in which they emerged, baffled all our efforts for a considerable time. At last one of the brood made for the shore, with the object of hiding among the grass and heather which fringed the margin of the lake. We pursued it as closely as we could, but when the little bird gained the shore our boat was still about twenty yards off. Long drought had left a broad margin of small flat stones and mud between the water and the usual bank. I saw the little bird run up about a couple of yards from the water, and then suddenly disappear. Knowing what was likely to be enacted, I kept my eye fixed on the spot, and when the boat was run upon the beach I proceeded to find and pick up the chick. But on reaching the place of disappearance, no sign of the young merganser was to be seen. The closest scrutiny, with the certain knowledge that it was there, failed to enable me to detect it. Proceeding cautiously forwards, I soon became convinced that I had already overshot the mark; and, on turning round, it was only to see the chick rise like an apparition from the stones, and, dashing past the stranded boat, regain the lake, where, having now recovered its wind, it instantly dived and disappeared. The tactical skill of the whole of this maneuver, and the success with which it was executed, were greeted with loud cheers from the whole party, and our admiration was not diminished when we remembered that some two weeks before that time the little performer had been coiled up inside the shell of an egg, and that about a month before it was apparently nothing but a mass of albumen and of fatty oils.—ARGYLL *Unity of Nature*, ch. 3, p. 50. (Burt.)

2551. PERFECTION OF MAN AS MAN—*Liberal vs. Professional Education—Bread-and-butter Sciences.*—Now, the perfection of man as an end, and the perfection of man as a mean or instrument, are not only not the same; they are, in reality, generally opposed. And as these two perfections are different, so the training requisite for their acquisition is not identical, and has, accordingly, been distinguished by different names. The one is styled liberal, the other professional, education; the branches of knowledge cultivated for these purposes being called, respectively, liberal and professional, or liberal and lucrative, sciences. By the Germans the latter are usually distinguished as the *Brodwissenschaften*, which we may translate the "Bread-and-butter sciences." A few of the professions, indeed, as requiring a higher development of the higher faculties, and involving, therefore, a greater or less amount of liberal education, have obtained the name of liberal professions. We must, however, recollect that this is only an accidental and a very partial exception. But tho the full and harmonious development of our faculties be the high and natural destination of all, while the cultivation of any professional dexterity is only a contingency, tho a contingency incumbent upon most, it has, however, happened that the paramount and universal end of man—of man absolutely—has been often ignorantly lost sight of, and the term "useful" appropriated exclusively to those acquirements which have a value only to man considered in his relative, lower, and accidental character of an instrument.—HAMILTON *Metaphysics*, lect. 1, p. 4. (G. & L., 1859.)

2552. PERFECTION OF MAN THE GOAL OF NATURE—*Evolution Exalts Humanity.*—To pursue unflinchingly the methods of science requires dauntless courage and a faith that nothing can shake. Such courage and such loyalty to Nature bring their own reward. For when once the formidable theory [of natural selection] is really understood, when once its implications are properly unfolded, it is seen to have no such logical consequences as were at first ascribed to it. As with the Copernican astronomy, so with the Darwinian biology, we rise to a higher view of the workings of God and of the nature of man than was ever attainable before. So far from degrading humanity, or putting it on a level with the animal world in general, the Darwinian theory shows us distinctly for the first time how the creation and the perfecting of man is the goal toward which Nature's work has all the while been tending. It enlarges tenfold the significance of human life, places it upon even a loftier eminence than poets or prophets have imagined, and makes it seem more than ever the chief object of that creative activity which is manifested in the physical universe.—FISKE *Destiny of Man*, ch. 2, p. 24. (H. M. & Co., 1900.)

2553. PERFECTION OF THE GEOLOGICAL RECORD—*Life History of the Trilobite in Stone.*—Their [the trilobites'] geological history has been very thoroughly studied; not only are we familiar with all their adult characters, but even their embryology is well known to naturalists. It is, indeed, wonderful that the mode of growth of animals which died out in the Carboniferous period should be better known to us than that of many living types. But it is nevertheless true that their embryonic forms have been found perfectly preserved in the rocks. . . . So complete is the sequence that the plate on which their em-

bryonic changes are illustrated contains more than thirty figures, all representing different phases of their growth. There is not a living crab represented so fully in any of our scientific works as is that one species of trilobite whose whole story Barrande has traced from the egg to its adult size.—AGASSIZ *Geological Sketches*, ser. i, ch. 2, p. 53. (H. M. & Co., 1896.)

2554. PERFECTION SHEDS LIGHT ON IMPERFECTION — *Complete Specimens Give Meaning to Fragments.*—But cases, tho few and rare, do occur in which, through some favorable accident connected with the death or sepulture of some individual existence of the period, its remains have been preserved almost entire; and one such specimen serves to throw light on whole heaps of the broken remains of its contemporaries. The single elephant, preserved in an iceberg beside the Arctic Ocean, illustrated the peculiarities of the numerous extinct family to which it belonged, whose bones and huge tusks whiten the wastes of Siberia. The human body found in an Irish bog, with the ancient sandals of the country still attached to its feet by thongs, and clothed in a garment of coarse hair, gave evidence that bore generally on the degree of civilization attained by the inhabitants of an entire district in a remote age. In all such instances the character and appearance of the individual bear on those of the tribe. In attempting to describe the organisms of the lower old red sandstone, where the fossils lie as thickly in some localities as herrings on our coasts in the fishing season, I felt as if I had whole tribes before me.—MILLER *The Old Red Sandstone*, ch. 9, p. 152. (G. & L., 1851.)

2555. PERIL DEFIED OR IGNORED —"*Sporting on the Volcano's Edge*"—*Prosperity and Happiness in the Endangered Lands.*—The first impression which is produced upon the mind, when the phenomena of volcanic action are studied, is that here we have exhibitions of destructive violence the effects of which must be entirely mischievous and disastrous to the living beings occupying the earth's surface. A little consideration will convince us, however, that the grand and terrible character of the displays of volcanic energy have given rise to exaggerated notions concerning their destructive effects. The fact that districts situated over the most powerful volcanic foci, like Java and Japan, are luxuriant in their productions, and thickly inhabited, may well lead us to pause ere we condemn volcanic action as productive only of mischief to the living beings on the earth's surface. The actual slopes of Vesuvius and Etna, and many other active volcanoes, are abundantly clothed with vineyards and forests, and are thickly studded with populous villages.—JUDD *Volcanoes*, ch. 10, p. 281. (A., 1899.)

2556. PERIL, FICTITIOUS—*No Lions in the Deserts—Vipers and Mosquitoes the Real Terrors.*—Of larger wild animals, only gazelles, wild asses, and ostriches are to be met with [in the Desert of Sahara]. "That lions exist in the desert," says M. Carette ["Exploration Scientif. de l'Algérie," t. ii, p. 332], "is a myth popularized by the dreams of artists and poets, and has no foundation but in their imagination. This animal does not quit the mountains, where it finds shelter, food, and drink. When the traveler questions the natives concerning these wild beasts, which Europeans suppose to be their companions in the desert, they reply, with imperturbable *sang-froid*, 'Have you, then, lions in your country which can drink air and eat leaves? With us, lions require running water and living flesh; and therefore they only appear where there are wooded hills and water. We fear only the viper *(lefa)*, and, in humid spots, the innumerable swarms of mosquitoes which abound there.'"—HUMBOLDT *Views of Nature*, p. 90. (Bell, 1896.)

2557. PERIL IN EXALTATION—*In Earthquake Countries, Lowliness Is Safety—Spaniards "Building Their Own Sepulchers."*—Another plan adopted in South America can be gathered from the same author's [James Douglas, in his "Journey along the West Coast of South America"] writings upon Lima, about which he says: "To build high houses would be to erect structures for the first earthquake to make sport of, and, therefore, in order to obtain space, safety, and comfort, the houses of the wealthy surround court after court, filled with flowers and cooled with fountains, connected one with another with wide passages which give a vista from garden to garden."

History would indicate that houses of this type have been arrived at as the results of experience, for it is said that when the inhabitants of South America first saw the Spaniards building tall houses they told them they were building their own sepulchers.

In Jamaica we find that even as early as 1692 experience had taught the Spaniards to construct low houses, which withstood shakings better than the tall ones.—MILNE *Earthquakes*, ch. 7, p. 127. (A., 1899.)

2558. PERIL UNIMAGINED—*A Slumbering Volcano—Vesuvius before the Eruption of A. D. 79—Its Slopes Vineyards—Its Crater a Fortress.*—Nothing is more certain than the fact that the Vesuvius upon which the ancient Romans and the Greek settlers of southern Italy looked, was a mountain differing entirely in its form and appearance from that with which we are familiar. The Vesuvius known to the ancients was a great truncated cone, having a diameter at its base of eight or nine miles, and a height of about 4,000 feet. The summit of this mountain was formed by a circular depressed plain, nearly three miles in diam-

eter, within which the gladiator Spartacus and his followers were besieged by a Roman army. There is no evidence that at this time the volcanic character of the mountain was generally recognized, and its slopes are described by the ancient geographers as being clothed with fertile fields and vineyards, while the hollow at the top was a waste overgrown with wild vines.

But in the year 79 a terrible and unexpected eruption occurred, by which . . . the cities of Pompeii, Herculaneum, and Stabiæ were overwhelmed and buried.—JUDD *Volcanoes*, ch. 4, p. 83. (A., 1899.)

2559. PERILS OF THE SNOW—*Traveler's Sense of Direction Destroyed by Swirling Eddies.*—Snow is not always our friend. . . . In thinly inhabited countries there is no greater danger than to be overtaken by a heavy fall of snow or caught in storms of snow-dust, raised from ground on which snow has previously fallen and whirled along by the wind. In such cases one's only safety is to make at once for the nearest human dwelling in sight. If there is none in sight, the danger of being lost is great, for nothing so destroys one's sense of direction as the confused eddies of falling snow or swirling snow-dust.—CHISHOLM *Nature-Studies*, p. 31. (Hum., 1888.)

2560. PERMANENCE, APPARENT—*Mountain Seems Eternal—A First View of the Matterhorn.*—Above us rise the towers and pinnacles of the Matterhorn, certainly a tremendous array. Actual contact immensely increases one's impressions of this, the hardest and strongest of all the mountain masses of the Alps; its form is more remarkable than that of other mountains, not by chance, but because it is built of more massive and durable materials, and more solidly put together: nowhere have I seen such astonishing masonry. The broad gneiss blocks are generally smooth and compact, with little appearance of splintering or weathering. Tons of rock, in the shape of boulders, must fall almost daily down its sides, but the amount of these, even in the course of centuries, is as nothing compared with the mass of the mountain; the ordinary processes of disintegration can have little or no effect on it. If one were to follow Mr. Ruskin, in speculating on the manner in which the Alpine peaks can have assumed their present shape, it seems as if such a mass as this can have been blocked out only while rising from the sea, under the action of waves such as beat against the granite headlands of the Land's End. Once on dry land it must stand as it does now, apparently forever.—HAWKINS in TYNDALL'S *Hours of Exercise in the Alps*, ch. 3, p. 39. (A., 1898.)

2561. ——— ——— *Transition Unperceived—Changing Cloud on Mountain Peak.*—You frequently see a streamer of cloud many hundred yards in length drawn out from an Alpine peak. Its steadiness appears perfect, tho a strong wind may be blowing at the same time over the mountain-head. Why is the cloud not blown away? It is blown away; its permanence is only apparent. At one end it is incessantly dissolved, at the other end it is incessantly renewed: supply and consumption being thus equalized, the cloud appears as changeless as the mountain to which it seems to cling. When the red sun of the evening shines upon these cloud streamers they resemble vast torches with their flames blown through the air.—TYNDALL *Forms of Water*, p. 29. (A., 1899.)

2562. PERMANENCE OF CONCEPTIONS—*Change of Conceptions Is Not Alteration, but Substitution.*—Each conception thus eternally remains what it is, and never can become another. The mind may change its states and its meanings at different times, may drop one conception and take up another, but the dropped conception can in no intelligible sense be said to change into its successor. The paper, a moment ago white, I may now see to have been scorched black. But my conception "white" does not change into my conception "black." On the contrary, it stays alongside of the objective blackness, as a different meaning in my mind, and by so doing lets me judge the blackness as the paper's change. Unless it stayed, I should simply say "blackness" and know no more. Thus, amid the flux of opinions and of physical things, the world of conceptions, or things intended to be thought about, stands stiff and immutable, like Plato's "Realm of Ideas."—JAMES *Psychology*, vol. i, ch. 12, p. 432. (H. H. & Co., 1899.)

2563. PERMANENCE OF LEVEL OF SWISS LAKES — *Extends at Least to the Bronze Age.*—As piles [in the remains of Swiss lake-dwellings] of the Bronze Age are sometimes found at a depth of as much as fifteen feet, and as it is manifest that buildings cannot have been constructed over water much deeper than this, it is evident that the Swiss lakes cannot then have stood at a much higher level than at present. This conclusion is confirmed by the position of Roman remains at Thonon, on the Lake of Geneva, and we thus obtain satisfactory evidence that the height of the Swiss lakes must have remained almost unaltered for a very long period.—AVEBURY *Prehistoric Times*, ch. 6, p. 176. (A., 1900.)

2564. PERPLEXITIES OF ETYMOLOGY—*Children Generalize from Different Starting-points—"Moon" and "Star"—So the Savage Children of the World.*—Examples of generalization among children abound in every nursery. A child is taken to the window by his nurse to see the moon. The easy monosyllable is caught up at once, and for some time the child applies it indiscriminately to anything bright or shining—the gas, the candle, the firelight are each "the moon." Mr. Romanes records a case where a

child made a similar use of the word "star" —the gas, the candle, the firelight were each "a star." If the makers of language proceeded on this principle, no wonder the philologist has riddles to read. How often must the savage children of the world have started off naming things from two such different points! — DRUMMOND *Ascent of Man*, ch. 5, p. 171. (J. P., 1900.)

2565. PERSEVERANCE OF INVENTOR — *Courage of Conviction — Self-sacrificing Enthusiasm.*—Somewhere about the time that Herschel set about polishing his first speculum, Pierre Louis Guinand, a Swiss artisan living near Chaux-de-Fonds, in the canton of Neuchâtel, began to grind spectacles for his own use, and was thence led on to the rude construction of telescopes by fixing lenses in pasteboard tubes. The sight of an English achromatic, however, stirred a higher ambition, and he took the first opportunity of procuring some flint-glass from England (then the only source of supply), with the design of imitating an instrument the full capabilities of which he was destined to be the humble means of developing. The English glass proving of inferior quality, he conceived the possibility, unaided and ignorant of the art as he was, of himself making better, and spent seven years (1784-90) in fruitless experiments directed to that end. Failure only stimulated him to enlarge their scale. He bought some land near Les Brenets, constructed upon it a furnace capable of melting two quintals of glass, and reducing himself and his family to the barest necessaries of life, he poured his earnings (he at this time made bells for repeaters) unstintingly into his crucibles. His undaunted resolution triumphed. In 1799 he carried to Paris and there showed to Lalande several disks of flawless crystal four to six inches in diameter. Lalande advised him to keep his secret, but in 1805 he was induced to remove to Munich, where he became the instructor of the immortal Fraunhofer. His return to Les Brenets in 1814 was signalized by the discovery of an ingenious mode of removing striated portions of glass by breaking and re-soldering the product of each melting, and he eventually attained to the manufacture of perfect disks up to 18 inches in diameter. An object-glass for which he had furnished the material to Cauchoix, procured him, in 1823, a royal invitation to settle in Paris; but he was no longer equal to the change, and died at the scene of his labors February 13 following.—CLERKE *History of Astronomy*, pt. i, ch. 6, p. 142. (Bl., 1893.)

2566. PERSEVERANCE OF SCIENCE —The grand campaign [for world-wide observation of the transit of Venus, 1874] had come to nothing. Nevertheless, no sign of discouragement was apparent. There was a change of view, but no relaxation of purpose. The problem, it was seen, could be solved by no single heroic effort, but by the patient approximation of gradual improvements. Astronomers, accordingly, looked round for fresh means, or more refined expedients for applying those already known. A new phase of exertion was entered upon.—CLERKE *History of Astronomy*, pt. ii, ch. 6, p. 292. (Bl., 1893.)

2567. ——— ——— *Fossils Found after Ten Years' Search.*— Immediately above the conglomerate there is a hundred and fourteen feet more of coarse sandstone strata, of a reddish yellow hue, with occasionally a few pebbles enclosed, and then twenty-seven feet additional of limestone and stratified clay. There are no breaks, no faults, no thinning out of strata—all the beds lie parallel, showing regular deposition. I had passed over the section twenty times before, and had carefully examined the limestone and the clay, but in vain. On this occasion, however, I was more fortunate. I struck off a fragment. It contained a vegetable impression of the same character with those of the ichthyolite beds; and after an hour's diligent search, I had turned out from the heart of the stratum plates and scales enough to fill a shelf in a museum—the helmet-like snout of an *Osteolepis*, the thorn-like spine of a *Cheiracanthus*, and a *Coccosteus* well-nigh entire. I had at length, after a search of nearly ten years, found the true place of the ichthyolite bed.—MILLER *The Old Red Sandstone*, ch. 7, p. 121. (G. & L., 1851.)

2568. ——— ——— *Kepler and the Orbit of Mars.*—It was this great eccentricity [of the orbit of Mars] which led Kepler to discover the true form of the planetary orbits, till then considered as perfectly circular; he took no less than seventeen years of labor to attain it, and very often he despaired of success.—FLAMMARION *Popular Astronomy*, bk. iv, ch. 4, p. 374. (A.)

2569. PERSISTENCE, GENUINE AND SPURIOUS — *Decision of Character.*—There is no more remarkable difference in human character than that between resolute and irresolute natures. . . . Whereas in the irresolute all decisions are provisional and liable to be reversed, in the resolute they are settled once for all and not disturbed again. Now into every one's deliberations the representation of one alternative will often enter with such sudden force as to carry the imagination with itself exclusively, and to produce an apparently settled decision in its own favor. These premature and spurious decisions are of course known to every one. They often seem ridiculous in the light of the considerations that succeed them. But it cannot be denied that in the resolute type of character the accident that one of them has once been made does afterwards enter as a motive additional to the more genuine reasons why it should not be revoked, or, if provisionally revoked, why it should be made again. How many of us persist in a precipitate course which,

but for a moment of heedlessness, we might never have entered upon, simply because we hate to "change our mind!"—JAMES *Psychology*, vol. ii, ch. 26, p. 530. (H. H. & Co., 1899.)

2570. PERSISTENCE OF A STRONG CURRENT IN ITS COURSE—*Rivers Saw Mountains Asunder.*—It is remarkable . . . how persistent are great rivers in maintaining their direction. When it has been once fairly established a large river may outlive many revolutions of the surface. River-valleys are not seldom older than the mountain ridges which they sometimes traverse; or, to put it in another way, new mountains may come into existence without deflecting the rivers across whose valleys they may seem at one time to have extended, for the rivers have simply sawed their way through the ridges as these were being gradually developed.—GEIKIE *Earth Sculpture*, ch. 3, p. 45. (G. P. P., 1898.)

2571. PERSONALITY AFFECTS SCIENTIFIC OBSERVATION—Every time that, in a given country, there is a change of observer we remark a sudden variation in the annual number of auroras. It is necessary, therefore, as far as possible, to collect the observations over a whole region, and not content ourselves with a single station, for it often happens that in two neighboring places an aurora will be noted in the one which is unperceived at the other by a less attentive observer.—ANGOT *Aurora Borealis*, ch. 5, p. 91. (A., 1897.)

2572. PERSONALITY AN INEVITABLE CONCEPTION—*Natural Agencies and Powers Personified.*—It is the simplest and most natural of all conceptions that the agency of which we are most conscious in ourselves is like the agency which works in the world around us. Even supposing this conception to be groundless, and that, as some now maintain, a more scientific investigation of natural agencies abolishes the conception of design or purpose, or of personal will being at all concerned therein—even supposing this, it is not the less true that the transfer of conceptions founded on our own consciousness of agency and of power within us to the agencies and powers around us, is a natural, if it be not indeed a necessary, conception. That it is a natural conception is proved by the fact that it has been, and still is, so widely prevalent, as well as by the fact that what is called the purely scientific conception of natural agencies is a modern conception, and one which is confessedly of difficult attainment. So difficult, indeed, is it to expel from the mind the conception of personality in or behind the agencies of Nature, that it may fairly be questioned whether it has ever been effectually done. Verbal devices for keeping the idea out of sight are indeed very common; but even these are not very successful. . . . Those naturalists and philosophers who are most opposed to all theological explanations or conceptions of natural forces do, nevertheless, habitually, in spite of themselves, have recourse to language which derives its whole form, as well as its whole intelligibility, from those elements of meaning which refer to the familiar operations of our own mind and will. The very phrase "natural selection" is one which likens the operations of Nature to the operations of a mind exercising the power of choice. The whole meaning of the phrase is to indicate how Nature attains certain ends which are like "selection."—ARGYLL *Unity of Nature*, ch. 11, p. 275. (Burt.)

2573. PERSONALITY A PRIMITIVE CONCEPTION—*Aryan Impersonations of Elementary Powers.*—From this evidence, as we find it in the facts reported respecting the earliest forms of Aryan speech, it seems certain that the most ancient conceptions of the energies of Nature were conceptions of personality. In that dim and far-off time, when our prehistoric ancestors were speaking in a language long anterior to the formation of the oldest Sanskrit, we are told that they called the sun the illuminator, or the warmer, or the nourisher; the moon, the measurer; the dawn, the awakener; the thunder, the roarer; the rain, the rainer; the fire, the quick-runner. We are told further that in these personifications the earliest Aryans did not imagine them as possessing the material or corporeal forms of humanity, but only that the activities they exhibited were most easily conceived as comparable with our own. Surely this is a fact which is worth volumes of speculation. What was most easy and most natural then must have been most easy and most natural from the beginning. With such a propensity in the earliest men of whom we have any authentic record to see personal agency in everything, and with the general impression of unity and subordination under one system which is suggested by all the phenomena of Nature, it does not seem very difficult to suppose that the fundamental conception of all religion may have been in the strictest sense primeval.—ARGYLL *Unity of Nature*, ch. 12, p. 304. (Burt.)

2574. PERSONALITY, DESTRUCTION OF—*Animal Made a True Automaton*—*Instinctless Condition of Brainless Pigeons.*—Schrader gives a striking account of the instinctless condition of his brainless pigeons, active as they were in the way of locomotion and voice. "The hemisphereless animal moves in a world of bodies which . . . are all of equal value for him. . . . He is, to use Goltz's apt expression, impersonal. . . . Every object is for him only a space-occupying mass; he turns out of his path for an ordinary pigeon no otherwise than for a stone. He may try to climb over both. All authors agree that they never found any difference, whether it was an inanimate body, a cat, a dog, or a bird of

prey which came in their pigeon's way. The creature knows neither friends nor enemies; in the thickest company it lives like a hermit.—JAMES *Psychology*, vol. i, ch. 2, p. 77. (H. H. & Co., 1899.)

2575. PERSONALITY EMBODIED—*The Secret of Idolatry.*—The universality of this tendency to connect some material objects with religious worship, and the immense variety of modes in which this tendency has been manifested, are facts which receive a full and adequate explanation in our natural disposition to conceive of all personal agencies as living in some form and in some place, or as having some other special connection with particular things in Nature. Nor is it difficult to understand how the embodiments, or the symbols, or the abodes, which may be imagined and devised by men, will vary according as their mental condition has been developed in a good or in a wrong direction. And as these imaginings and devices are never as we see them now among savages, the work of any one generation of men, but are the accumulated inheritance of many generations, all existing systems of worship among them must be regarded as presumably very wide departures from the conceptions which were primeval.—ARGYLL *Unity of Nature*, ch. 11, p. 283. (Burt.)

2576. PERSONALITY INDIVIDUAL AND INCOMMUNICABLE—*Limit to the Possibility of Human Sympathy—A Lesson of Charity.*—There is a something in the intimacy of a man's own experience which he cannot make to pass entire into the heart and mind even of his most familiar companion, and thus it is that he is so often defeated in his attempts to obtain a full and a cordial possession of his sympathy. He is mortified, and he wonders at the obtuseness of the people around him, and that, with every human being he addresses, justness of his complainings, nor to feel the point upon which turn the truth and the reason of his remonstrances, nor to give their interested attention to the case of his peculiarities and of his wrongs, nor to kindle, in generous resentment, along with him, when he starts the topic of his indignation. He does not reflect, all the while, that, with every human being he addresses, there is an inner man, which forms a theater of passions, and of interests as busy, as crowded, and as fitted as his own to engross the anxious and the exercised feelings of a heart, which can alone understand its own bitterness, and lay a correct estimate on the burden of its own visitations. Every man we meet carries about with him, in the unperceived solitude of his bosom, a little world of his own, and we are just as blind, and as insensible, and as dull, both of perception and of sympathy, about his engrossing objects as he is about ours; and, did we suffer this observation to have all its weight upon us, it might serve to make us more candid, and more considerate of others. It might serve to abate the monopolizing selfishness of our nature.—CHALMERS *Astronomical Discourses*, p. 42. (R. Ct., 1848.)

2577. PHANTOMS KNOWN AS ILLUSIONS—*Specters Haunting a Scholar.*—We knew a gentleman of strong mind, and a most accomplished scholar, who was for many years subject to such fantasms, some sufficiently grotesque, and he would occasionally laugh heartily at their antics. Sometimes it appeared as if they interrupted a conversation in which he was engaged; and then, if with his family or intimate friends, he would turn to empty space, and say, "I don't care a farthing for ye; ye amuse me greatly sometimes, but you are a bore just now." His spectra, when so addressed, would to his eye resume their antics, at which he would laugh, turn to his friend, and continue his conversation. In other respects he was perfectly healthy, his mind was of more than ordinary strength, and he would speak of his fantoms, and reason upon their appearance, being perfectly conscious that the whole was illusive. —CARPENTER *Mental Physiology*, bk. i, ch. 4, p. 167. (A., 1900.)

2578. PHANTOMS OF IMAGINATION—*The Illusions of Desire.*—Long before the discovery of the New World it was believed that new lands in the far West might be seen from the shores of the Canaries and the Azores. These illusive images were owing, not to any extraordinary refraction of the rays of light, but produced by an eager longing for the distant and the unattained. The philosophy of the Greeks, the physical views of the Middle Ages, and even those of a more recent period have been eminently imbued with the charm springing from similar illusive fantoms of the imagination. At the limits of circumscribed knowledge, as from some lofty island shore, the eye delights to penetrate to distant regions. The belief in the uncommon and the wonderful lends a definite outline to every manifestation of ideal creation; and the realm of fancy—a fairy-land of cosmological, geognostical, and magnetic visions—becomes thus involuntarily blended with the domain of reality.—HUMBOLDT *Cosmos*, vol. i, p. 81. (H., 1897.)

2579. PHENOMENA MANIFESTATIONS OF ONE OMNIPRESENT POWER—*Conservation of Energy.*—All those who have most carefully studied the subject have arrived at the same results. There is, therefore, every reason to believe that the principle we have been illustrating is universally true. Let us then embody it in a definite statement. *All natural phenomena are the manifestation of the same omnipresent energy, which is transferred from one portion of matter to another without loss.*

But if the principle as thus stated be accepted we cannot rest here, for it in-

volves this further conclusion, which, however marvelous, must be true: *The sum total of all the active and latent energies in the universe is constant and invariable.* In other words, power is as indestructible as matter.

This grand truth is generally called the law of conservation of energy, and if it cannot as yet be regarded as absolutely verified there can be no question that it stands on a better basis to-day than did the law of gravitation one hundred years ago.—COOKE *Religion and Chemistry,* ch. 10, p. 302. (A., 1897.)

2580. PHENOMENA, NATURAL, RANGED UNDER LAW—*Religious Phenomena Need Like Classification.*—The effect of the introduction of law among the scattered phenomena of Nature has simply been to make science, to transform knowledge into eternal truth. The same crystallizing touch is needed in religion. Can it be said that the phenomena of the spiritual world are other than scattered? Can we shut our eyes to the fact that the religious opinions of mankind are in a state of flux? And when we regard the uncertainty of current beliefs, the war of creeds, the havoc of inevitable as well as of idle doubt, the reluctant abandonment of early faith by those who would cherish it longer if they could, is it not plain that the one thing thinking men are waiting for is the introduction of law among the phenomena of the spiritual world? When that comes we shall offer to such men a truly scientific theology. And the reign of law will transform the whole spiritual world as it has already transformed the natural world.—DRUMMOND *Natural Law in the Spiritual World,* pref., p. 8. (H. Al.)

2581. PHENOMENA OF NATURE MISINTERPRETED—*Aurora Borealis Mistaken for Conflagration.*—Seneca ("Naturales Questiones," i, 14, 15) says: "Among these phenomena should be ranged those appearances as of the heavens on fire so often reported by historians; sometimes these fires are high enough to shine among the stars; at others, so low that they might be taken for the reflection of a distant burning homestead or city. This is what happened under Tiberius, when the cohorts hurried to the succor of the colony of Ostia, believing it to be on fire. During the greater part of the night the heaven appeared to be illuminated by a faint light resembling a thick smoke."—ANGOT *Aurora Borealis,* ch. 1, p. 5. (A., 1897.)

2582. PHENOMENA REDUCED TO LAW—*Divested of Superstition.*—It is no small gain to have established the fact that volcanic phenomena, divested of all those wonderful attributes with which superstition and the love of the marvelous have surrounded them, are operations of Nature obeying definite laws, which laws we may hope by careful observation and accurate reasoning to determine; and that the varied appearances, presented alike in the grandest and feeblest outbursts, can all be referred to one simple cause—namely, the escape, from the midst of masses of molten materials, of imprisoned steam or water-gas.—JUDD *Volcanoes,* ch. 2, p. 38. (A., 1899.)

2583. PHILOSOPHY, ENDLESS PROBLEM OF—*The Mystery of Evil.*—Well-nigh universally has philosophy proceeded upon the assumption, whether tacit or avowed, that pain and wrong are things hard to be reconciled with the theory that the world is created and ruled by a Being at once all-powerful and all-benevolent. Why does such a Being permit the misery that we behold encompassing us on every side? . . . If this question could be fairly answered, does it not seem as if the burden of life, which so often seems intolerable, would forthwith slip from our shoulders and leave us, like Bunyan's pilgrim, free and bold and light-hearted to contend against all the ills of the world?—FISKE *Through Nature to God,* pt. i, ch. 3, p. 11. (H. M. & Co., 1900.)

2584. PHILOSOPHY OF HABIT—Dr. Carpenter's phrase that our nervous system grows to the modes in which it has been exercised expresses the philosophy of habit in a nutshell.—JAMES *Psychology,* vol. i, ch. 4, p. 112. (H. H. & Co., 1899.)

2585. PHOSPHORESCENCE, BACTERIAL—*Cause of, Unknown.*—Several species of sea-water bacteria themselves possess powers of phosphorescence. Pflüger was the first to point out that it was such organisms which provided the phosphorescence upon decomposing wood or decaying fish. To what this light is due, whether capsule, or protoplasm, or chemical product, is not yet known. The only facts at present established are to the effect that certain kinds of media and pabulum favor or deter phosphorescence.—NEWMAN *Bacteria,* ch. 1, p. 26. (G. P. P., 1899.)

2586. PHOSPHORESCENCE OF DEEP SEA—*Animals Light Their Own Abode.*—Altho it is highly probable that not a glimmer of sunlight ever penetrates to the depths of the ocean, there is in some places, undoubtedly, a very considerable illumination due to the phosphorescence of the inhabitants of the deep waters. All the alcyonarians are, according to Moseley, brilliantly phosphorescent when brought to the surface. Many deep-sea fish possess phosphorescent organs, and it is quite possible that many of the deep-sea protozoa, tunicates, jellyfish, and crustacea are in their native haunts capable of giving out a very considerable amount of phosphorescent light.—HICKSON *Fauna of the Deep Sea,* ch. 2, p. 25. (A., 1894.)

2587. ——— ———*Light Not Universal—Caves of Darkness—Eyeless Organisms.*—The entire absence or rudimentary condition of the eyes of a very considerable

proportion of deep-sea animals seems to prove that the phosphorescent illumination is not universally distributed, and that there must be some regions in which the darkness is so absolute that it can only be compared with the darkness of the great caves.—HICKSON *Fauna of the Deep Sea*, ch. 2, p. 27. (A., 1894.)

2588. PHOSPHORESCENCE OF THE OCEAN — *Porpoises Swimming in Paths of Light.*—Standing at the bow and looking forwards, at a distance of forty or fifty yards from the ship, a number of luminous streamers were seen rushing towards us. On nearing the vessel they rapidly turned, like a comet round its perihelion, placed themselves side by side, and in parallel trails of light kept up with the ship. One of them placed itself right in front of the bow as a pioneer. These comets of the sea were joined at intervals by others. Sometimes as many as six at a time would rush at us, bend with extraordinary rapidity round a sharp curve, and afterwards keep us company. I leaned over the bow and scanned the streamers closely. The frontal portion of each of them revealed the outline of a porpoise. The rush of the creatures through the water had started the phosphorescence, every spark of which was converted by the motion of the retina into a line of light. Each porpoise was thus wrapped in a luminous sheath. The phosphorescence did not cease at the creature's tail, but was carried many porpoise-lengths behind it.—TYNDALL *Fragments of Science*, ch. 6, p. 149. (A., 1897.)

2589. ——— ——— *Radiance from Death.*—Sometimes one cannot, even with high magnifying powers, discover any animalcules in the luminous water; and yet, wherever a wave breaks in foam against a hard body, and, indeed, wherever water is violently agitated, flashes of light become visible. The cause of this phenomenon depends probably on the decomposing fibers of dead mollusca, which are diffused in the greatest abundance throughout the water. If this luminous water be filtered through finely woven cloths the fibers and membranes appear like separate luminous points. When we bathed at Cumana, in the Gulf of Cariaco, and walked naked on the solitary beach in the beautiful evening air, parts of our bodies remained luminous from the bright fibers and organic membranes which adhered to the skin, nor did they lose this light for some minutes. If we consider the enormous quantity of mollusca which animate all tropical seas, we can hardly wonder that sea-water should be luminous, even where no fibers can be visibly separated from it.—HUMBOLDT *Views of Nature*, p. 249. (Bell, 1896.)

2590. PHOSPHORUS, DELUSION OF —*Chemistry of Brain Action Little Known.* —Chemical action must of course accompany brain activity. But little definite is known of its exact nature. Cholesterin and creatin are both excrementitious products, and are both found in the brain. The subject belongs to chemistry rather than to psychology, and I only mention it here for the sake of saying a word about a wide-spread popular error about brain activity and phosphorus. "*Ohne Phosphor kein Gedanke* [no thought without phosphorus]" was a noted war-cry of the "materialists" during the excitement on that subject which filled Germany in the '60s. The brain, like every other organ of the body, contains phosphorus and a score of other chemicals besides. Why the phosphorus should be picked out as its essence, no one knows. It would be equally true to say "*Ohne Wasser kein Gedanke* [no thought without water]," or "*Ohne Kochsalz kein Gedanke* [no thought without salt]"; for thought would stop as quickly if the brain should dry up or lose its NaCl as if it lost its phosphorus. —JAMES *Psychology*, vol. i, ch. 3, p. 101. (H. H. & Co., 1899.)

2591. PHOTOGRAPHY AS AN AID TO ASTRONOMY—*A Photographic Survey of the Heavens.*—Perhaps the most marvelous of all achievements of photography is in the field of astronomy. Every increase in the size and power of the telescope has revealed to us ever more and more stars in every part of the heavens; but by the aid of photography stars are shown which no telescope that has been or that probably ever will be constructed, can render visible to the human eye. For by exposing the photographic plate in the focus of the object-glass for some hours almost infinitely faint stars impress their image, and the modern photographic star-maps show us a surface densely packed with white points that seem almost as countless as the sands of the seashore. . . . A photographic survey of the heavens is now in progress on one uniform system, which when completed will form a standard for future astronomers, and thus give to our successors some definite knowledge of the structure and perhaps of the extent of the stellar universe.—WALLACE *The Wonderful Century*, ch. 5, p. 32. (D. M. & Co., 1899.)

2592. PHOTOGRAPHY, CUMULATIVE EFFECT OF—*Extending Time of Exposure Compensates for Feebleness of Light—No Cumulative Power in the Eye—Vision the Recognition of a Series of Photographs.*—Seeing may be described, not wholly inaptly, as the recognition of a series of brief successive photographs taken by the optic lens on the retina; but the important difference between seeing and photographing, which we now ask attention to, is this: When the eye looks at a faint object, such as the spectrum of a star, or at the still fainter nebula, this, as we know, appears no brighter at the end of half an hour than at the end of the first half-second. In other words, after a brief fraction of a second, the visual effect does not sensibly accumulate. But in

the action of the photograph, on the contrary, the effect *does* accumulate, and in the case of a weak light accumulates indefinitely. It is owing to this precious property that, supposing (for illustration merely) the lightning flash to have occupied the one-thousandth part of a second in impressing itself on the plate, to get a nearly similar effect from a continuous light one thousand times weaker, we have only to expose the plate a thousand times as long—that is, for one second; while from a light a million times weaker we should get the same result by exposing it a million times as long—that is, for a thousand seconds.—LANGLEY *New Astronomy*, ch. 8, p. 244. (H. M. & Co., 1896.)

2593. PHOTOGRAPHY FINDS NO TRACE OF SUNLIGHT IN DEEP SEA—The more recent experiments that have been made tend to show that no sunlight whatever penetrates to a greater depth, to take an extreme limit, than 500 fathoms. Fol and Sarasin, experimenting with very sensitive bromo-gelatin plates, found that there was no reaction after ten minutes' exposure at a depth of 400 meters on a sunny day in March.—HICKSON *Fauna of the Deep Sea*, ch. 2, p. 25. (A., 1894.)

2594. PHOTOGRAPHY PICTURES THE INVISIBLE—*Finds Stars in the Blackness of Space.*—Mr. H. C. Russell, at Sydney, in 1890, successfully imitated Professor Barnard's example. His photographs of the southern Milky Way have many points of interest. They show the great rift, so black to the eye, as densely star-strewn to the perception of the chemical retina, while the "Coal-sack" appears absolutely dark only in its northern portion.—CLERKE *History of Astronomy*, pt. ii, ch. 12, p. 508. (Bl., 1893.)

2595. ——— ——— *The Photograph Secures What the Telescope Fails to Reveal—One Hour of Photographic Exposure Surpasses Years of an Astronomer's Labor.*—The writer remembers the interest with which he heard Dr. Draper, not long before his lamented death, speak of the almost incredible sensitiveness of these most recent photographic processes, and his belief that we were fast approaching the time when we should photograph what we could not even see. The time has now arrived. At Cambridge, in Massachusetts, and at the Paris Observatory, by taking advantage of the cumulative action we have referred to, and by long exposures, photographs have recently been taken showing stars absolutely invisible to the telescope, and enabling us to discover faint nebulæ whose previous existence had not been suspected; and when we consider that an hour's exposure of a plate now not only secures a fuller star-chart than years of an astronomer's labor, but a more exact one, that the art is every month advancing perceptibly over the last, and that it is already, as we may say, not only making pictures of what we see, but of what we cannot see even with the telescope, we have before us a prospect whose possibilities no further words are needed to suggest.—LANGLEY *New Astronomy*, ch. 8, p. 247. (H. M. & Co., 1896.)

2596. PHRENOLOGY, ABSOLUTE LIMIT OF—*Power of Brain Dependent on Convolutions.*—No account can be taken [by phrenology] of an increased number of convolutions. Supposing that the size of each faculty be due to the amount of gray matter in the convolution, then an additional convolution will greatly increase the amount of gray matter, but will not alter the shape of the skull situated above this portion of the brain. This is important, as, from observations which have been made, it is found that the brain is more convoluted in persons of superior intelligence.—ELDRIDGE-GREEN *Memory and Its Cultivation*, ch. 5, p. 38. (A., 1900.)

2597. PHRENOLOGY IGNORES ELEMENTS—*Answers Problem by Restatement.*—Phrenology hardly does more than restate the problem. To answer the question, "Why do I like children?" by saying, "Because you have a large organ of philoprogenitiveness," but renames the phenomenon to be explained. What is my philoprogenitiveness? Of what mental elements does it consist? And how can a part of the brain be its organ? A science of the mind must reduce such complex manifestations as "philoprogenitiveness" to their elements. A science of the brain must point out the functions of its elements. A science of the relations of mind and brain must show how the elementary ingredients of the former correspond to the elementary functions of the latter. But phrenology, except by occasional coincidence, takes no account of elements at all.—JAMES *Psychology*, vol. i, ch. 2, p. 28. (H. H. & Co., 1899.)

2598. PHYSICS, CELESTIAL—*The New Contrasted with the Old Astronomy—Study of the Nature, and Not Merely of the Position, of the Heavenly Bodies.*—The prime object of astronomy, until very lately, indeed, has still been to say where any heavenly body is, and not what it is. It is this precision of measurement, then, which has always—and justly—been a paramount object of this oldest of the sciences, not only as a good in itself, but as leading to great ends; and it is this which the poet of Urania has chosen rightly to note as its characteristic when he says:

> That little vernier, on whose slender lines
> The midnight taper trembles as it shines,
> Tells through the mist where dazzled Mercury burns,
> And marks the point where Uranus returns.

But within a comparatively few years a new branch of astronomy has arisen which studies sun, moon, and stars for what they are in themselves and in relation to ourselves. Its study of the sun, beginning with its external features (and full of novelty

and interest, even, as regards those), led to the further inquiry as to what it was made of, and then to finding the unexpected relations which it bore to the earth and our own daily lives on it, the conclusion being that, in a physical sense, it made us and re-creates us, as it were, daily, and that the knowledge of the intimate ties which unite man with it brings results of the most practical and important kind, which a generation ago were unguessed at.

This new branch of inquiry is sometimes called celestial physics, sometimes solar physics, and is sometimes more rarely referred to as the new astronomy.—LANGLEY *The New Astronomy*, ch. 1, p. 3. (H. M. & Co., 1896.)

2599. PHYSIOLOGY AGAINST THE MATERIALIST — *Thought Not in Brain—Molecular Movements Are but Concomitants of Mental Action.*—The only thing which cerebral physiology tells us, when studied with the aid of molecular physics, is against the materialist, so far as it goes. It tells us that during the present life, altho thought and feeling are always manifested in connection with a peculiar form of matter, yet by no possibility can thought and feeling be in any sense the products of matter. Nothing could be more grossly unscientific than the famous remark of Cabanis, that the brain secretes thought as the liver secretes bile. It is not even correct to say that thought goes on in the brain. What goes on in the brain is an amazingly complex series of molecular movements with which thought and feeling are in some unknown way correlated, not as effects or as causes, but as concomitants.—FISKE *Destiny of Man*, ch. 16, p. 109. (H. M. & Co., 1900.)

2600. PICTURE DRAWN BY LIGHTNING STROKE—*Form Photographed in Death.*—When a disruptive discharge takes place through the air between two conductors, in many cases a part of the matter of each conductor is transferred to the other. [Accounts have been] received . . . from different sources of a remarkable phenomenon connected with this action. In the case of a person killed many years ago by lightning, while standing near to the whitewashed wall of a room, the discharge took place between his body and the wall, and on the latter was depicted, in dark color, an image of his person. Other cases of the same kind had been observed.—HENRY *Scientific Writings*, vol. i, p. 293. (Sm. Inst., 1886.)

2601. PICTURE-WRITING—*Transition from Hieroglyph to Sound-sign—Phonograph Returns to the Actual Sound.*—In examining the methods of writing, we began with the rude hunter's pictures, passing on to the Egyptian's use of a picture to represent the sound of its name, then to the breaking down of the picture into a mere sound-sign, till in this last stage the connection between figure and sound becomes so apparently arbitrary that the child has to be taught, this sign stands for A, this for B. In curious contrast with this is the modern invention of the phonograph, where the actual sound spoken into the vibrating diaphragm marks indentations in the traveling strip of tinfoil, by which the diaphragm can be afterwards caused to repeat the vibrations and reutter the sound. When one listens to the tones coming forth from the strip of foil the South Sea Islander's fancy of the talking chip seems hardly unreasonable.—TYLOR *Anthropology*, ch. 7, p. 181. (A., 1899.)

2602. PIGMENTS DIFFER FROM RAYS—*No Natural Color Is Pure—Blue and Yellow Lights Do Not Make Green.*—You will find it stated in many books that blue and yellow lights mixed together produce green. But blue and yellow have been just proved to be complementary colors, producing white by their mixture. The mixture of blue and yellow pigments undoubtedly produces green, but the mixture of pigments is totally different from the mixture of lights. Helmholtz has revealed the cause of the green in the case of a mixture of blue and yellow pigments. No natural color is pure. A blue liquid or a blue powder permits not only the blue to pass through it, but a portion of the adjacent green. A yellow powder is transparent not only to the yellow light, but also in part to the adjacent green. Now, when blue and yellow are mixed together the blue cuts off the yellow, the orange, and the red; the yellow, on the other hand, cuts off the violet, the indigo, and the blue. Green is the only color to which both are transparent, and the consequence is that when white light falls upon a mixture of yellow and blue powders the green alone is sent back to the eye.—TYNDALL *Lectures on Light*, lect. 1, p. 37. (A., 1898.)

2603. PILOTS OF CIVILIZATION—*The Buffalo a Pioneer—Bison-tracks Show the Best Passes over Mountains.*—It is also a remarkable fact that the North-American bison, or buffalo, has exerted an influence on geographical discoveries in pathless mountain districts. These animals advance in herds of many thousands in search of a milder climate, during winter, in the countries south of the Arkansas River. Their size and cumbrous forms render it difficult for them to cross high mountains on these migratory courses, and a well-trodden buffalo-path is therefore followed wherever it is met with, as it invariably indicates the most convenient passage across the mountains. Thus buffalo-paths have indicated the best tracks for passing over the Cumberland Mountains in the southwestern parts of Virginia and Kentucky, and over the Rocky Mountains between the sources of the Yellowstone and Platte rivers, and between the southern branch of the Columbia and the Californian Rio Colorado.—HUMBOLDT *Views of Nature*, p. 42. (Bell, 1896.)

2604. PITCH LAKE OF TRINIDAD—*Dead Forests Decomposed by Volcanic Fires.*—Fluid bitumen is seen to ooze from the bottom of the sea on both sides of the island of Trinidad, and to rise up to the surface of the water. Near Cape La Braye there is a vortex which, in stormy weather, according to Captain Mallet, gushes out, raising the water five or six feet, and covers the surface for a considerable space with petroleum or tar; and the same author quotes Gumilla as stating, in his "Description of the Orinoco," that about seventy years ago a spot of land on the western coast of Trinidad, near half-way between the capital and an Indian village, sank suddenly and was immediately replaced by a small lake of pitch, to the great terror of the inhabitants.

It is probable that the great pitch lake of Trinidad owes its origin to a similar cause; and Dr. Nugent has justly remarked that in that district all the circumstances are now combined from which deposits of pitch may have originated. The Orinoco has for ages been rolling down great quantities of woody and vegetable bodies into the surrounding sea, where, by the influence of currents and eddies, they may be arrested and accumulated in particular places. The frequent occurrence of earthquakes and other indications of volcanic action in those parts lend countenance to the opinion that these vegetable substances may have undergone, by the agency of subterranean fire, those transformations and chemical changes which produce petroleum; and this may, by the same causes, be forced up to the surface, where, by exposure to the air, it becomes inspissated, and forms the different varieties of pure and earthy pitch, or asphaltum, so abundant in the islands.—LYELL *Principles of Geology*, bk. ii, ch. 16, p. 250. (A., 1854.)

2605. PITILESSNESS OF NATURAL FORCES—*Contrast with Human Power—The Sense of the Sublime.*—The air [on the Matterhorn] was preternaturally still; an occasional gust came eddying round the corner of the mountain, but all else seemed strangely rigid and motionless and out of keeping with the beating heart and moving limbs, the life and activity, of man. Those stones and ice have no mercy in them, no sympathy with human adventure; they submit passively to what man can do; but let him go a step too far, let heart or hand fail, mist gather or sun go down, and they will exact the penalty to the uttermost. The feeling of "the sublime" in such cases depends very much, I think, on a certain balance between the forces of Nature and man's ability to cope with them: if they are too weak, the scene fails to impress; if they are too strong for him, what was sublime becomes only terrible.—TYNDALL *Hours of Exercise in the Alps*, ch. 3, p. 44. (A., 1898.)

2606. PLACE OF BACTERIA IN NATURE—*First Deemed Animals—Now Ascertained To Be Plants—Animals Have No Monopoly of Motion.*—For a considerable period of time after their first detection these unicellular organisms [bacteria] were considered to be members of the animal kingdom. As late as 1838, when Ehrenberg and Dujardin drew up their classification, bacteria were placed among the infusorians. This was in part due to the powers of motion which these observers detected in bacteria. It is now, of course, recognized that animals have no monopoly of motion. But what, after all, are the differences between animals and vegetables so low down in the scale of life? Chiefly two: there is a difference in life history (in structure and development), and there is a difference in diet. . . . It is true, they [bacteria] possess motion, are free from chlorophyl, and even feed occasionally upon products of decomposition—three physiological characters which would ally them to the animal kingdom. Yet by their structure and capsule of cellulose and by their life history and mode of growth they unmistakably proclaim themselves to be of the vegetable kingdom. In 1853 Cohn arrived at a conclusion to this effect, and since that date they have become more and more limited in classification and restricted in definition.—NEWMAN *Bacteria*, ch. 1, p. 5. (G. P. P., 1899.)

2607. PLACE OF EXPERIMENTS IN SCIENCE—*The Investigator Addresses Inquiries to Nature—The Teacher Presents Her Answers to the Public.*—Experiments have two great uses—a use in discovery and verification, and a use in tuition. They were long ago defined as the investigator's language addressed to Nature, to which she sends intelligible replies. These replies, however, usually reach the questioner in whispers too feeble for the public ear. But after the discoverer comes the teacher, whose function it is so to exalt and modify the experiments of his predecessor as to render them fit for public presentation.—TYNDALL *Lectures on Light*, lect. 1, p. 3. (A., 1898.)

2608. PLACE OR PERSON JUMBLED IN MEMORY—*Accidental Association—Light on Some Questions of Veracity.*—Thus, for example, I may have lent a book to a friend last week. I really remember the act of lending it, but have forgotten the person. But I am not aware of this. The picture of memory has unknowingly to myself been filled up by this unconscious process of shifting and rearrangement, and the idea of another person has by some odd accident got substituted for that of the real borrower. If we could go deeply enough into the matter, we should, of course, be able to explain why this particular confusion arose. We might find, for example, that the two persons were associated in my mind by a link of resemblance, or that I had dealings with the other person about the same time.

Similarly, when we manage to join an event to a wrong place, we may find that it is because we heard of the occurrence when staying at the particular locality, or in some other way had the image of the place closely associated in our minds with the event. But often we are wholly unable to explain the displacement.—SULLY *Illusions*, ch. 10, p. 266. (A., 1897.)

2609. PLAN AND PURPOSE MARK HUMANITY—*Passion, Appetite, and Desire Subdued to One Supreme Volition.*—To plan, to purpose, . . . is to exercise all the faculties of developed manhood, under the control of will. Yet this, like all other complex manifestations of those faculties, is also matter of degrees. We should not, therefore, by any means confine our estimate of such products of will to those who can say with the Paracelsus of Browning:

> I have subdued my life to the one purpose
> Whereto I ordained it;

or, again:

> I have made my life consist of one idea,

however grand the idea and noble the sentiment belonging to the plan. The lower order of savages, and the average man of the civilized community, do indeed suffer themselves to be swayed by internal passions and external circumstances rather than "subdue" their lives to any "one purpose." And yet there is another side to all this. They, too, as sharers in the possibilities of human development, habitually take large sections, as it were, of their own lives into their own keeping; they "ordain" them to some one purpose (tho it may be no nobler purpose than to take vengeance on an enemy; to excel in trapping game, or in outdressing and outranking others, or in bulling or bearing the market): and they subdue ideas and feelings and minor volitions to this one purpose. They thus rise above the lower animals and show the leading characteristics of a distinctively human development.—LADD *Psychology*, ch. 26, p. 630. (S., 1899.)

2610. PLAN FOR SCIENTIFIC CONQUEST OF THE GLOBE—Humboldt gave the first impulse, at the Scientific Congress of Berlin in 1828, to a great international movement for attacking simultaneously, in various parts of the globe, the complex problem of terrestrial magnetism. Through the genius and energy of Gauss, Göttingen became its center. Thence new apparatus and a new system for its employment issued. . . . The letter addressed by Humboldt in April, 1836, to the Duke of Sussex as president of the Royal Society, enlisted the cooperation of England. A network of magnetic stations was spread all over the British dominions, from Canada to Van Diemen's Land; measures were concerted with foreign authorities, and an expedition was fitted out, under the able command of Captain (afterwards Sir James) Clark Ross, for the special purpose of bringing intelligence on the subject from the dismal neighborhood of the south pole. In 1841 the elaborate organization created by the disinterested efforts of scientific "agitators" was complete; Gauss's "magnetometers" were vibrating under the view of attentive observers in five continents, and simultaneous results began to be recorded. —CLERKE *History of Astronomy*, pt. ii, ch. 1, p. 157. (Bl., 1893.)

2611. PLAN MANIFESTED BY BEES—*Scouts Select Home for New Colony.*—M. de Fravière had the opportunity of observing the manner in which such an examination [of a new hive, by bees] is carried on, and with what prudence and accuracy. He placed an empty beehive, made in a new style, in front of his house, so that he could exactly watch from his own window what went on inside and out without disturbance to himself or to the bees. A single bee came and examined the building, flying all round it and touching it. It then let itself down on the board, and walked carefully and thoroughly over the interior, touching it continually with its antennæ so as to subject it on all sides to a thorough investigation. The result of its examination must have been satisfactory, for after it had gone away it returned accompanied by a crowd of some fifty friends, which now together went through the same process as their guide. This new trial must also have had a good result, for soon a whole swarm came, evidently from a distant spot, and took possession. Still more remarkable is the behavior of the scouts when they take possession of a satisfactory hive or box for an imminent or approaching swarm. Altho it is not yet inhabited they regard it as their property, watch it and guard it against stranger bees or other assailants, and busy themselves earnestly in the most careful cleansing of it, so far as this cleansing is impossible to the setter up of the hive. Such a taking possession sometimes occurs eight days before the entrance of the swarm. —ROMANES *Animal Intelligence*, ch. 4, p. 168. (A., 1899.)

2612. PLAN REVEALED IN RUDIMENTARY ORGANS—*History or Prophecy.* —In this point of view rudimentary or aborted organs need no longer puzzle us, for in respect to purpose they may be read either in the light of history or in the light of prophecy. They may be regarded as indicating always either what had already been or what was yet to be. Why new creations should never have been made wholly new; why they should have been always molded on some preexisting forms; why one fundamental ground-plan should have been adhered to for all vertebrate animals—we cannot understand. But as a matter of fact, it is so.—ARGYLL *Reign of Law*, ch. 4, p. 122. (Burt.)

2613. PLANET COOLED BY CELESTIAL SPACES—*Crust Wrinkling into Mountains.*—Astronomy shows us our planet

thrown off from the central mass of which it once formed a part, to move henceforth in an independent orbit of its own. That orbit, it tells us, passed through celestial spaces cold enough to chill this heated globe, and of course to consolidate it externally. . . . The first effect of cooling the surface of our planet must have been to solidify it, and thus to form a film or crust over it. That crust would shrink as the cooling process went on; in consequence of the shrinking, wrinkles and folds would arise upon it; and here and there, where the tension was too great, cracks and fissures would be produced. In proportion as the surface cooled, the masses within would be affected by the change of temperature outside of them, and would consolidate internally also, the crust gradually thickening by this process.—AGASSIZ *Geological Sketches*, ser. i, ch. 1, p. 6. (H. M. & Co., 1896.)

2614. PLANETS REVOLVE ROUND OTHER SUNS—*Variation of Algol Due to Eclipse.*—The most celebrated variable star, Algol, or β Persei, examined many times at the epoch of its minimum brightness, has always shown the type of Vega . . . from which we may conclude that the variation of the star is not due to a chemical phenomenon, that the star does not change, and is doubtless eclipsed by a planet of its system which passes in front of it. This idea, previously suggested, of attributing the periodical diminution of the brightness of Algol to an eclipse produced by an opaque body revolving round the star, agrees, moreover, very well with the regularity of the phenomenon and with the short duration of the phase of light-diminution.—FLAMMARION *Popular Astronomy*, bk. vi, ch. 6, p. 612. (A.)

2615. PLANS, VAST AND IMPRESSIVE, OF PRIMITIVE MAN—*The Mound-builders' Creations.*—The enclosure known as "Clark's Work," in Ross County, Ohio, is one of the largest and most interesting. It consists of a parallelogram, two thousand eight hundred feet by eighteen hundred, and enclosing about one hundred and eleven acres. To the right of this, the principal work is a perfect square, containing an area of about sixteen acres. Each side is eight hundred and fifty feet in length, and in the middle of each is a gateway thirty feet wide, covered by a small mound. Within the area of the great work are several smaller mounds and enclosures, and it is estimated that not less than three millions of cubic feet of earth were used in this great undertaking. Yet from the peculiarly mottled character of the earth forming these mounds, it would appear to have been brought in bags or small parcels. It has also been observed that water is almost invariably found within or close to these enclosures.—AVEBURY *Prehistoric Times*, ch. 8, p. 245. (A 1900.)

2616. PLANT, INSECTIVOROUS, CLOSING ON ITS PREY—*Struggles of Victim Seal Its Doom.*—If a small organic or inorganic object be placed on the glands in the center of a leaf [of sundew], these transmit a motor impulse to the marginal tentacles. The nearer ones are first affected and slowly bend towards the center, and then those farther off, until at last all become closely inflected over the object. This takes place in from one hour to four or five or more hours. The difference in the time required depends on many circumstances; namely, on the size of the object and on its nature, that is, whether it contains soluble matter of the proper kind; on the vigor and age of the leaf; whether it has lately been in action; and, according to Nitschke, on the temperature of the day, as likewise seemed to me to be the case. A living insect is a more efficient object than a dead one, as in struggling it presses against the glands of many tentacles. An insect, such as a fly, with thin integuments, through which animal matter in solution can readily pass into the surrounding dense secretion, is more efficient in causing prolonged inflection than an insect with a thick coat, such as a beetle. The inflection of the tentacles takes place indifferently in the light and darkness; and the plant is not subject to any nocturnal movement of so-called sleep.—DARWIN *Insectivorous Plants*, ch. 1, p. 7. (A., 1900.)

2617. PLANT LIFTS MINERAL TO LIVING WORLD—*Divine Life Must Uplift from Natural to Spiritual World.*—There being no passage from one kingdom to another, whether from inorganic to organic, or from organic to spiritual, the intervention of life is a scientific necessity if a stone or a plant or an animal or a man is to pass from a lower to a higher sphere. The plant stretches down to the dead world beneath it, touches its minerals and gases with its mystery of life, and brings them up ennobled and transformed to the living sphere. The breath of God, blowing where it listeth, touches with its mystery of life the dead souls of men, bears them across the bridgeless gulf between the natural and the spiritual, between the spiritually inorganic and the spiritually organic, endows them with its own high qualities, and develops within them those new and secret faculties by which those who are born again are said to "see the kingdom of God."—DRUMMOND *Natural Law in the Spiritual World*, int., p. 64. (H. Al.)

2618. PLANTS EXTENDED BY RUNNERS—*Numerous Progeny of a Single Plant.*—The spreading of strawberries by runners must be familiar to every observer. In 1894 a student reported that a wild strawberry plant in the botanic garden had produced in that year 1,230 plants. Weeds were all kept away, the season was favorable, the soil sandy; but on one side, within a foot

and a half, progress was checked by the presence of a large plant of another kind.—BEAL *Seed Dispersal*, ch. 3, p. 13. (G. & Co., 1898.)

2619. PLANTS IN SUBTERRANEAN CAVITIES—*Ejected in Volcanic Eruption.*—In what manner did the solid coverings of these most minute plants and animalcules, which can only originate and increase at the surface of the earth, sink down and penetrate into subterranean cavities, so as to be ejected from the volcanic orifices? We have of late years become familiar with the fact, in the process of boring Artesian wells, that the seeds of plants, the remains of insects, and even small fish, with other organic bodies, are carried in an uninjured state by the underground circulation of waters, to the depth of many hundred feet. With still greater facility in a volcanic region we may conjecture that water and mud full of invisible infusoria may be sucked down, from time to time, into subterranean rents and hollows in cavernous lava which has been permeated by gases, or in rocks dislocated by earthquakes. It often happens that a lake which has endured for centuries in a volcanic crater disappears suddenly on the approach of a new eruption. Violent shocks agitate the surrounding region, and ponds, rivers, and wells are dried up. Large cavities far below may thus become filled with fen mud chiefly composed of the more indestructible and silicious portions of infusoria, destined, perhaps, to be one day ejected in a fragmentary or half-fused state, yet without the obliteration of all traces of organic structure.—LYELL *Principles of Geology*, bk. ii, ch. 24, p. 389. (A., 1854.)

2620. PLANTS OF NORTH AMERICA FOUND IN JAPAN—*Poison-ivy and Poison-oak—Correspondence of Far-off Lands.*—Our *Rhus Toxicodendron*, or poison-ivy, is very exactly repeated in Japan, but is found in no other part of the world, altho a species much like it abounds in California. Our other poisonous *rhus (R. venenata)*, commonly called poison-dogwood, is in no way represented in Western America, but has so close an analog in Japan that the two were taken for the same by Thunberg and Linnæus, who called them both *R. vernix*.—ASA GRAY *Darwiniana*, art. 5, p. 221. (A., 1889.)

2621. PLANTS PROTECTED AGAINST USELESS INSECTS—*Slippery Surfaces an Impassable Barrier.*—Protection [of many flowers against ants is secured] by means of slippery surfaces. In this case, also, the leaves often form a collar round the stem, with curvèd surfaces over which ants cannot climb. "I have assured myself," says Kerner, "not only by observation, but by experiment, that wingless insects, and notably ants, find it impossible to mount upwards over such leaves as these. The little creatures run up the stem, and may even not unfrequently traverse the undersurface of the leaves, if not too smooth; but the reflexed and slippery margin is more than the best climbers among them can get over, and if they attempt it they invariably fall to the ground. There is no necessity for the lamina of the leaf to be very broad; even narrow leaves, as, for instance, those of *Gentiana firma*, are enough for the purpose, supposing, of course, that the margin is bent backwards in the way described." Of this mode of protection the cyclamen and snowdrop offer familiar examples. In vain do ants attempt to obtain access to such flowers: the curved surfaces baffle them; when they come to the edge they inevitably drop off to the ground again. In fact, these pendulous flowers protect the honey as effectually from the access of ants as the hanging nests of the weaver and other birds protect their eggs and young from the attacks of reptiles.—AVEBURY *Ants, Bees, and Wasps*, ch. 3, p. 52. (A., 1900.)

2622. PLANTS SUPPLIED WITH NITROGEN BY MICRO-ORGANISMS—*Bacteria of Nitrification.*—Nitrification occurs in two stages, each stage performed by a distinct organism. By one *(nitrosomonas)*, ammonia is converted into nitrite; by the other *(nitrobacter)*, the nitrite is converted into nitrate [in which latter form alone the plant can use it]. Both organisms are widely and abundantly distributed in the superficial soils. They act together and in conjunction and for one common purpose. They are separable by employing favorable media. . . . They belong to the soil, river-water, and sewage. They are also said to be frequently present in well-water. From some experiments at Rothamsted it appears that the organisms occur mostly in the first twelve inches, and in subsoils of clay down to three or four feet. In sandy soils nitrification may probably occur at a greater depth.—NEWMAN *Bacteria*, ch. 5, p. 158. (G. P. P., 1899.)

2623. PLANTS WITH GOOD INTENTIONS—*A Relapse into Parasitism—The Dodder.*—There are certain plants—the dodder, for instance—which begin life with the best intentions, strike true roots into the soil, and really appear as if they meant to be independent for life. But after supporting themselves for a brief period they fix curious sucking disks into the stem and branches of adjacent plants. And after a little experimenting, the epiphyte finally ceases to do anything for its own support, thenceforth drawing all its supplies ready-made from the sap of its host. In this parasitic state it has no need for organs of nutrition of its own, and Nature therefore takes them away. Henceforth, to the botanist, the adult dodder presents the degraded spectacle of a plant without a root, without a twig, without a leaf, and having a stem so useless as to be inadequate to bear its own weight.—DRUMMOND *Natural Law in the Spiritual World*, essay 9, p. 285. (H. Al.)

2624. PLASTICITY CHARACTERIZES LIFE—*The Crystal Changeless—The Plant Immobile—The Animal Free—The Soul More Mobile Still.*—Now plasticity is not only a marked characteristic of all forms of life, but in a special sense of the highest forms. It increases steadily as we rise in the scale. The inorganic world, to begin with, is rigid. A crystal of silica dissolved and redissolved a thousand times will never assume any other form than the hexagonal. The plant next, tho plastic in its elements, is comparatively insusceptible of change. The very fixity of its sphere, the imprisonment for life in a single spot of earth, is the symbol of a certain degradation. The animal in all its parts is mobile, sensitive, free; the highest animal, man, is the most mobile, the most at leisure from routine, the most impressionable, the most open for change. And when we reach the mind and soul this mobility is found in its most developed form. Whether we regard its susceptibility to impressions, its lightning-like response even to influences the most impalpable and subtle, its power of instantaneous adjustment, or whether we regard the delicacy and variety of its moods or its vast powers of growth, we are forced to recognize in this the most perfect capacity for change. This marvelous plasticity of mind contains at once the possibility and prophecy of its transformation.—DRUMMOND *Natural Law in the Spiritual World,* essay 8, p. 269. (H. Al.)

2625. PLATES, THIN, COLORS OF—*Illustrated by Colored Films on Molten Lead.*—"We took a quantity of clean lead and melted it with a strong fire, and then immediately pouring it out into a clean vessel of convenient shape and matter (we used one of iron, that the great and sudden heat might not injure it), and then carefully and nimbly taking off the scum that floated on the top we perceived, as we expected, the smooth and glossy surface of the melted matter to be adorned with a very glorious color, which being as transitory as delightful did almost immediately give place to another vivid color, and that was as quickly succeeded by a third, and this, as it were, chased away by a fourth; and so these wonderfully vivid colors successively appeared and vanished till the metal, ceasing to be hot enough to hold any longer this pleasing spectacle, the colors that chanced to adorn the surface when the lead thus began to cool remained upon it, but were so superficial that how little soever we scraped off the surface of the lead we did, in such places, scrape off all the color." [See FILMS; COLORS; LIGHT, DOUBLE REFLECTION OF.]—BOYLE *Experimental History of Colors,* quoted by TYNDALL in *Lectures on Light,* lect. 2, p. 68. (A., 1898.)

2626. PLAY AN INDICATION OF INTELLIGENCE—Over against the countless varieties of the play of children, reflecting all conceivable relations of life, stands the single form of mock fighting among the animals. (Trained animals do not, of course, concern us; their performances are not real play.) Dogs, cats, and monkeys, even when they are playing with their young, show their affection by pretending to fight with them. And tho it is true that play is an indication of high mental development, and brings the animal nearer to ourselves than any other activity, it is rather the fact that it plays than the nature of the play itself which is the important point. . . . Animal play never shows any inventiveness, any regular and orderly working out of some general idea.—WUNDT *Psychology,* lect. 24, p. 358. (Son. & Co., 1896.)

2627. PLAY AS AN ART OF PLEASURE—*Sports of Children Imitative.*—Play is one of the arts of pleasure. It is doing for the sake of doing, not for what is done. One class of games is spontaneous everywhere, the sports in which children imitate the life they will afterwards have to act in earnest. Eskimo children play at building snow-huts, and their mothers provide them with a tiny oil-lamp with a bit of wick to set burning inside. Among the savages whose custom it is to carry off their wives by force from neighboring tribes, the children play at the game of wife-catching, just as, with us, children play at weddings with a clergyman and bridesmaids. All through civilization toy weapons and implements furnish children at once play and education; the North-American warrior made his boy a little bow and arrow as soon as he could draw it, and the young South Sea Islander learned by throwing a reed at a rolling ring how in after-life to hurl his spear. It is curious to see that when growing civilization has cast aside the practical use of some ancient contrivance it may still survive as a toy, as where Swiss children to this day play at making fire by the Old-World plan of drilling one piece of wood into another; and in our country lanes the children play with bows and arrows and slings, the serious weapons of their forefathers.—TYLOR *Anthropology,* ch. 12, p. 305. (A., 1899.)

2628. PLAY OF YOUNG ANIMALS AND OF CHILDREN—The play of man and the animals differs in the same way as their "intelligence." We regard certain actions of the higher animals as playful when they take the form of imitations of purposive voluntary actions. We know that they are imitations because the end pursued is only a fictitious end—the real end being excitation of joyous emotions similar to those which follow as secondary effects from genuine purposive action. That means, you see, that the play of animals is, for all practical purposes, identical with play among mankind. Our own play, at least in its simpler forms—*e. g.*, in the play of children—is merely an imitation of the actions of every-day life

stripped of its original purpose, and resulting in pleasurable emotion.—WUNDT *Psychology*, lect. 24, p. 357. (Son. & Co., 1896.)

2629. PLAYHOUSES OF THE BOWER-BIRD—*Love of the Beautiful—Esthetic Sense in Animals—Stealing of Bright and Attractive Objects.*—Some animals exhibit emotions of the beautiful. The following is Mr. Gould's description, *in extenso*, of the habits of the bower-bird of New South Wales: The extraordinary bower-like structure, alluded to in my remarks on the genus, first came under my notice in the Sydney Museum, to which an example had been presented by Charles Cox, Esq. . . . On visiting the cedar bushes of the Liverpool Range, I discovered several of these bowers or playing-houses on the ground, under the shelter of the branches of the overhanging trees, in the most retired part of the forest; they differed considerably in size, some being a third larger than others. The base consists of an extensive and rather convex platform of sticks firmly interwoven, on the center of which the bower itself is built. This, like the platform on which it is placed, and with which it is interwoven, is formed of sticks and twigs, but of a more slender and flexible description, the tips of the twigs being so arranged as to curve inwards and nearly meet at the top; in the interior the materials are so placed that the forks of the twigs are always presented outwards, by which arrangement not the slightest obstruction is offered to the passage of the birds. The interest of this curious bower is much enhanced by the manner in which it is decorated with the most gaily colored articles that can be collected, such as the blue tail-feathers of the Rose-hill and Pennantian parrakeets, bleached bones, and shells of snails, etc.; some of the feathers are inserted among the twigs, while others, with the bones and shells, are strewed near the entrances. The propensity of these birds to fly off with any attractive object is so well known to the natives that they always search the runs for any small missing article that may have been accidentally dropped in the bush. I myself found at the entrance of one of them a small, neatly worked stone tomahawk of an inch and a half in length, together with some slips of blue cotton rag, which the birds had doubtless picked up at a deserted encampment of the natives.—ROMANES *Animal Intelligence*, ch. 10, p. 279. (A., 1899.)

2630. PLEASURE AND PAIN, EXPRESSION OF—*Tension or Relaxation of Muscles.*—In this law of pleasure and pain we have the key to the leading varieties of expression of the feelings. The organs of expression by movement are primarily the features, next the voice, lastly the movements and gestures of the body at large—head, trunk, and extremities. In pleasurable emotions these are unquestionably rendered active; the grimaces, gestures, and attitudes show an accession of active power. The notable circumstances in this display are the general erection of the body, the opening up of the features, the powerful exercise of the voice; all showing that the extensor muscles, which are by far the largest, are strongly stimulated. When we have surplus energy to expend we stretch and extend the body in preference to bending and relaxing it; the weight of the body itself is borne in the one case and not in the other. Any additional strain, as in walking, lifting weights, rowing a boat, is borne by the extensor muscles. It is the size of these that makes the muscular figure, the fulness of the calves, the thighs, and the hips. On the other hand, pain (not violently acute), dejection, depression, leads to the relaxation of all these powerful muscles; hence a general stooping and collapse of the figure, showing that the springs of muscular force have dried up. The difference of the two situations, as regards the carriage of the whole body, is most marked. Compare the victor in a triumph with one of his captives—the attitude of the beater with the beaten. And as regards the face, how much is suggested by the one descriptive trait, "His countenance fell"!—BAIN *Mind and Body*, ch. 4, p. 17. (Hum., 1880.)

2631. PLEASURE, STRANGE, IN DESOLATION—*The Question of the Wilderness.*—The plain as usual consisted of gravel, mingled with soil resembling chalk in appearance, but very different from it in nature. From the softness of these materials it was worn into many gulleys. There was not a tree, and, excepting the guanaco, which stood on the hilltop, a watchful sentinel over its herd, scarcely an animal or a bird. All was stillness and desolation. Yet in passing over these scenes, without one bright object near, an ill-defined but strong sense of pleasure is vividly excited. One asked how many ages the plain had thus lasted, and how many more it was doomed thus to continue.

> None can reply—all seems eternal now.
> The wilderness has a mysterious tongue,
> Which teaches awful doubt.
> —SHELLEY, *Lines on Mont Blanc.*

—DARWIN *Naturalist's Voyage around the World*, ch. 8, p. 168. (A., 1898.)

2632. PLEDGE, UTILITY OF—*A Strong Initiative.*—In the acquisition of a new habit or the leaving off of an old one, we must take care to launch ourselves with as strong and decided an initiative as possible. Accumulate all the possible circumstances which shall reenforce the right motives; put yourself assiduously in conditions that encourage the new way; make engagements incompatible with the old; take a public pledge, if the case allows; in short, envelop your resolution with every aid you know. This will give your new beginning such a momentum that the temptation to break down will not occur as soon as it otherwise

might; and every day during which a break-down is postponed adds to the chances of its not occurring at all.—JAMES *Talks to Teachers*, ch. 8, p. 67. (H. H. & Co., 1900.)

2633. PLEIADES, ORIGIN OF THE NAME—*The Mariner's Guide in Heaven.*—The Pleiades [were] doubtless known to the rudest nations from the earliest times; the mariner's stars—Pleias, ἀπὸ τοῦ πλεῖν (from πλεῖν, to sail), according to the etymology of the old scholiast of Aratus, who is probably more correct than those modern writers who would derive the name from πλεός plenty. The navigation of the Mediterranean lasted from May to the beginning of November, from the early rising to the early setting of the Pleiades.—HUMBOLDT *Cosmos*, vol. iii, p. 141. (H., 1897.)

2634. POET SHOWS TRUE SCIENTIFIC INSIGHT—The description given by Strabo and Pausanias of this elevation [the Hill of Methone, now Methana, in the peninsula of Trœzene] led one of the Roman poets, most celebrated for his richness of fancy, to develop views which agree in a remarkable manner with the theory of modern geognosy. "Near Trœzene is a tumulus, steep and devoid of trees, once a plain, now a mountain. The vapors enclosed in dark caverns in vain seek a passage by which they may escape. The heaving earth, inflated by the force of the compressed vapors, expands like a bladder filled with air, or like a goatskin. The ground has remained thus inflated, and the high projecting eminence has been solidified by time into a naked rock." Thus picturesquely and, as analogous phenomena justify us in believing, thus truly has Ovid described that great natural phenomenon which occurred 282 years before our era.—HUMBOLDT *Cosmos*, vol. i, p. 240. (H., 1897.)

2635. POETRY HAS EXISTED WITHOUT SCIENCE—*Knowledge Increases Appreciation of the Order, Rhythm, and Beauty of Nature.*—I do not thus think well, or indeed anything, of the doctrine that a poetry nursed in utter ignorance of the scientific aspects of Nature presents us with an essentially typical development of the poetic faculty. No one can deny that in the absence of all scientific knowledge, that faculty may be developed to sing in loftiest strains and fullest measure. But I enter a strong protest against the misrepresentation that the scientific faculty destroys the poetic, or that, of necessity, an exact method of looking at things should utterly annul the sense wherewith we discover their external beauty or the wondrous and subtle rhythm and measure that pervade the universe at large.—ANDREW WILSON *Science and Poetry*, p. 10. (Hum., 1888.)

2636. POETRY, INDESTRUCTIBLE POWER OF—*Science Not to Supersede—The Poetry of Science.*—That poetry must ever assert a powerful influence on man's estate, no reasonable being may doubt. It is too closely bound up with the personal history of man in all stages of civilization, too nearly related to his inmost mind, as the expression of his deepest emotions, to fall into decay even when it lights upon a grossly utilitarian time. The song of victory, the pæan of joy, the "*Io triumphe*" of the conqueror, or the coronach and lament for the dead, are expressions wherein the true poetry of our nature bursts forth in spite of ourselves; whilst developing from these more rugged and primitive sources, as a softened stream passes sidewards from a mountain torrent, we find the cultured soul of the poet communing with Nature, and teaching us new and better feelings, and the glory of a higher life. It is not saying too much, then, to predict that the true mission of poetry is that of leading us to see fairer aspects of things, to cultivate the beauty-sense, and to lead us to see Nature in her thousand moods, even if the thoughts it evokes are ofttimes "too deep for tears." Poetry thus becomes the handmaid of culture, and still more of religion. Science it may never attempt to supersede, altho there is and must be a poetry of knowledge. . . . But poetry, as the expression of the deepest emotions of the human soul, can never fade. In her records lie embalmed, as in a treasure-house, the thoughts of the far-back past, and the noblest sentiments which humanity may express. Such are the functions of true poesy, and such the mission of those

Who on earth have made us heirs
Of truth and pure delight by heavenly lays!

—ANDREW WILSON *Science and Poetry*, p. 11. (Hum., 1888.)

2637. POINTS, DEBATABLE, SETTLED—*Many Nebulæ Are Star-clusters—Some Are Certainly Gas-clouds.*—I have spoken hitherto of nebulæ as star-cloudlets, and unquestionably large numbers of these objects are really composed of stars, and give forth the same sort of light (in general respects) as our sun and other single stars. But others have been shown by the researches of our great physicist, Dr. Huggins, to be composed of luminous gas or vapor. The famous nebula in Orion is among the number thus constituted; so are the dumb-bell nebula in Vulpecula, the ring nebula in Lyra, and other well-known objects. In the southern hemisphere the great nebula in Argo has been shown to be gaseous (by Captain Herschel), and the fine, irregular nebula in the greater Magellanic Cloud is another of these gaseous masses. The strange objects called the planetary nebulæ are also all gaseous, so far as these researches have yet extended.—PROCTOR *Our Place among Infinities*, p. 227. (L. G. & Co., 1897.)

2638. POISON, ALCOHOL A—*Is It also a Food?*—The reader of this paper may criticize the wording of the question contained

in the title, for no one can dispute that alcohol is a poison, that it can destroy animal or vegetable protoplasm, that if taken in large doses it produces disease and has a paralyzing action, and, like all other poisons, if taken in small doses it has a stimulating effect. The question, therefore, ought to read: Can alcohol, despite its unquestionable toxic properties, also act as a food?—KASSOWITZ *Is Alcohol a Food or a Poison? (a Lecture)*, p. 1. (Translation by Mrs. J. H. W. STUCKENBERG.)

2639. ——— ——— *Phosphorus Has Closely Similar Effects—Neither To Be Classed as a Food.*—Since alcohol has a destructive action upon protoplasm, and since the process of oxidation of protoplasm is intimately connected with its activity, it is self-evident that a diminution in the amount of protoplasm must entail a diminished decomposition of protoplasm due to this activity, and hence, also, a diminished oxidation of its decomposition products.

That the action of a poison actually can lead to such results is plainly evident in the consequences of phosphoric poisoning, which, precisely like alcoholic poisoning, leads, on the one hand, to an increased excretion of nitrogen, an expression of toxic destruction of protoplasm, and, on the other, to a very considerable decrease in the taking in of oxygen and the giving out of carbon dioxid. Of course, it is not to be thought of that the oxidation of the small quantity of phosphorus ample to produce that effect could save fat by withdrawing the oxygen at its disposal; rather, it is perfectly clear that the protoplasm destroyed by the poisonous action of phosphorus (while fat is split off and nitrogen excreted) can no longer take part in the vital processes of oxidation. Hence, if we chose to call the toxic alcohol a food on the ground that it limits physiological processes of oxidation by means of destroying protoplasm, we should be obliged to declare phosphorus a much more valuable food, because much smaller doses diminish the normal processes of oxidation by destroying protoplasm. But even the most rigid doctrinaire could scarcely be made to agree with this view.—KASSOWITZ *Is Alcohol a Food or a Poison? (a Paper)*, p. 13. (Translation by Mrs. J. H. W. STUCKENBERG.)

2640. POISON OF CAYENNE—*Aids to Digestion—Dinner Pills—Attempt to Evade Penalty of Overindulgence—Illness in India.*—The mere condiment is a stimulating drug that does its work directly upon the inner lining of the stomach by exciting it to increased and abnormal activity. A dyspeptic may obtain immediate relief by using Cayenne pepper. Among the advertised patent medicines is a pill bearing the very ominous name of its compounder, the active constituent of which is Cayenne. Great relief and temporary comfort are commonly obtained by using it as a "dinner pill." If thus used only as a temporary remedy for an acute or temporary or exceptional attack of indigestion, all is well, but the Cayenne, whether taken in pills or dusted over the food or stewed with it in curries or any other wise, is one of the most cruel of slow poisons when taken habitually. Thousands of poor wretches are crawling miserably towards their graves, the victims of the multitude of maladies of both mind and body that are connected with chronic, incurable dyspepsia, all brought about by the habitual use of Cayenne and its condimental cousins.

The usual history of these victims is that they began by overfeeding, took the condiment to force the stomach to do more than its healthful amount of work, using but a little at first. Then the stomach became tolerant of this little, and demanded more; then more, and more, and more, until at last inflammation, ulceration, torpidity, and finally the death of the digestive powers, accompanied with all that long train of miseries to which I have referred. India is their special fatherland.—WILLIAMS *Chemistry of Cookery*, ch. 15, p. 260. (A., 1900.)

2641. POISONING, CUMULATIVE, FROM SUPPOSEDLY INNOCENT SUBSTANCE—*Boracic Acid as a Preservative of Milk.*—Boracic acid is one of the most useful antiseptics with which to wash sore eyes or preserve tinned foods or milk. It is not a strong germicide, but an unirritating and effective wash. Many cases of its addition to milk have found their way into the law courts, owing to cumulative poisoning, and it should only be used with the very greatest care as a food preservative.—NEWMAN *Bacteria*, ch. 9, p. 322. (G. P. P., 1899.)

2642. POISONS OF MICROBES MUTUALLY DESTRUCTIVE—*Antagonisms of Bacteria.*—Whatever [direct] opposition one species affords to another it is able to exercise by means of its poisonous properties. These are of two kinds. There is, as is now widely known, the poisonous product named the *toxin*. . . . There is also in many species, as Dr. Klein has pointed out, a poisonous constituent or constituents included in the body protoplasm of the bacillus, and which he therefore terms the *intracellular poison*. Now, whilst the former is different in every species, the latter may be a property common to several species. Hence those having a similar intracellular poison are antagonistic to each other, each member of such a group being unable to live in an environment of its own intracellular poison. Further, it has been suggested that there are organisms possessing only one poisonous property, namely, their toxin—for example, the bacilli of tetanus and diphtheria—whilst there are other species, as above, possessing a double poisonous property, an intracellular poison and a toxin. In this latter class would be included the bacilli of anthrax and tubercle.—NEWMAN *Bacteria*, ch. 1, p. 34. (G. P. P., 1899.)

2643. POLARIZATION OF LIGHT—*Tourmalin Quenches All but One Set of Vibrations—Two Crossed Plates Produce Darkness.*—We may begin the study of the polarization of light, with ease and profit, by means of a crystal of tourmalin. But we must start with a clear conception of an ordinary beam of light. It has been already explained that the vibrations of the individual ether-particles are executed across the line of propagation. In the case of ordinary light we are to figure the ether-particles as vibrating in all directions, or azimuths, as it is sometimes expressed, across this line. Now, in the case of a plate of tourmalin cut parallel to the axis of the crystal, a beam of light incident upon the plate is divided into two, the one vibrating parallel to the axis of the crystal, the other at right angles to the axis. The grouping of the molecules and of the ether associated with the molecules reduces all the vibrations incident upon the crystal to these two directions. One of these beams, namely, that whose vibrations are perpendicular to the axis, is quenched with exceeding rapidity by the tourmalin. To such vibrations many specimens of the crystal are highly opaque, so that, after having passed through a very small thickness of the tourmalin, the light emerges with all its vibrations reduced to a single plane. In this condition it is what we call *plane polarized light.*

A moment's reflection will show that, if what is here stated be correct, on placing a second plate of tourmalin with its axis parallel to the first, the light will pass through both; but that, if the axes be crossed, the light that passes through the one plate will be quenched by the other, a total interception of the light being the consequence.—TYNDALL *Lectures on Light,* lect. 3, p. 115. (A., 1898.)

2644. POLITICS AN EDUCATION—*Increasing Knowledge of Social Laws—Provision against Pauperism.*—The very attempt of the working classes to govern through combination their own affairs, and to determine their own condition, is an education in itself. On the extended scale on which that attempt is being made it must accustom them to consider great general causes, and to estimate the manner and the degree in which these can be effected by the methods of adjustment. Last, not least, it must lead them to study and to recognize the moral duties which are indeed the most fundamental of all natural laws. For it ought to be remembered that the first and most important object of combinations is one against which there can be no opposition founded on the doctrines of economic science. That object is to secure for the working classes those provisions against misfortune, sickness, accident, and age which are amongst the first duties of all organized societies of men. How far through such agency the causes of pauperism may be successfully attacked is a question on which we are only entering. In like manner, the conditions and limitations under which combination may succeed in blending the functions and in uniting the profits of capital and of labor—this also is a question to be determined by natural laws, not yet fully explored or understood.—ARGYLL *Reign of Law,* ch. 7, p. 226. (Burt.)

2645. POLLUTION AT THE SOURCE—*Foul Springs and Wells Spread Disease.*—Gathering-grounds are frequently the locality of the pollution. The recent Maidstone epidemic is an example. Here some of the springs supplying the town with water were contaminated by several typhoid patients. Frequently on the gathering-ground one may find a number of houses the waste and refuse of which will furnish ample surface pollution, which in its turn may readily pass into a collecting reservoir or a well. Only recently the writer investigated the cause of typhoid in a large country house, and traced it to pollution of the private well by surface washings from the stable quarters. Leakage of house-drains into wells is not an infrequent source of contamination.—NEWMAN *Bacteria,* ch. 2, p. 82. (G. P. P., 1899.)

2646. POLYGAMY NOT PRIMEVAL—*General Equality of the Sexes.*—We have seen that the cruel treatment of the female sex is almost universal among savages, and that it is entirely unknown among the lower animals. It is in the highest degree improbable and unnatural to suppose that this habit can have been primeval. But the same considerations carry us a great deal farther. They raise a presumption in favor of the later origin of other habits and customs which are not confined to the savage state, but have prevailed and do now prevail among nations comparatively civilized [such as polygamy and marriage by capture.] There can have been no polygamy when as yet there was only a single pair, or when there were several single pairs widely separated from each other. The presumption, if not the certainty, therefore, is that primeval man must have been monogamous. It is a presumption supported by the general equality of the sexes in respect to the numbers born, with only just such an excess of the male sex as tends to maintain that equality against the greater risks to life arising out of manly pursuits and duties. Thus the facts of Nature point to polygamy as in all probability a departure from the habits of primeval times.—ARGYLL *Unity of Nature,* ch. 10, p. 229. (Burt.)

2647. POTTER'S WHEEL KNOWN FROM EARLY ANTIQUITY—All power at first was hand power; the machinery of the world was moved only by human muscles. . . . Winds and water currents gradually have been domesticated for human uses in savagery. The study of these is

essential to a knowledge of industrial progress. The Zuñi woman's extremely simple potter's wheel, which is nothing more than the turning of her vessel about in a box of dry sand as the work goes on, is only a little more rude than the fashion in the interior of China of putting a lump of clay on the top of a revolving shaft which they turn with one hand while the pot is formed with the other. The potter's wheel was known in the world from high antiquity. The Africans push a mass of clay around with one hand and form it with the other. —MASON *Aboriginal American Mechanics (Memoirs of the International Congress of Anthropology,* p. 80). (Sch. R. C.)

2648. POTTERY, ANCIENT, MODELED ON BASKETWORK — Prompted, it may be, by the very act of making a coiled basket, the ancient potter rolled out a fillet or slender cylinder of prepared paste about the thickness, say, of a chalk crayon. Every one who reads these lines has more than once seen children playing with putty, rolling it out into fillets and then coiling it. The cook also makes little cakes after the same process, and the tidy housewife supplies herself thus with mats for her tables.

The ancient potter also coiled her fillet of soft clay around and around in an orderly manner, pinching as she went. . . . This work was done occasionally on the outside of a basket, bowl, or another vase. But the work was more frequently built up by the hands, guided chiefly by the eye, until the vessel was finished. Luckily for the student, many vessels are left in the corrugated condition produced by the pinching and coiling. These examples not only show the process here referred to, but they evidence a marvelous variety of finger-nail and finger-tip work.—MASON *Woman's Share in Primitive Culture,* ch. 5, p. 98. (A., 1894.)

2649. POTTERY, IMPORTANCE OF, TO PRIMITIVE MAN — Before the introduction of metallic vessels the art of the potter was more important even than it is at present. Accordingly, the sites of all ancient habitations are generally marked by numerous fragments of pottery; this is as true of the ancient Indian settlements as of the Celtic towns of England or the lake villages of Switzerland.—AVEBURY *Prehistoric Times,* ch. 8, p. 242. (A., 1900.)

2650. POTTERY, ORIGIN OF, LOST IN PREHISTORIC TIMES—*The Potter's Wheel in Egypt—A Type of Creation—Hand-made Pottery in Hebrides.*—In Europe, as any museum of antiquities shows, the funeral urns and other earthen vessels of the Stone and Bronze ages were hand-made; and even now tourists who visit the Hebrides buy earthen cups and bowls of an old woman who makes them in ancestral fashion without a potter's wheel, and ornaments them with lines drawn with a pointed stick. Yet the potter's wheel was known in the world from high antiquity . . . , as shown in the wall-paintings of the Tombs of the Kings. It is seen that they turned the wheel by hand. So the Hindu potter is described as now going down to the riverside when a flood has brought him a deposit of fine clay, when all he has to do is to knead a batch of it, stick up his pivot in the ground, balance the heavy wooden table on the top, give it a spin round, and set to work. It was an improvement on this simplest wheel to work it from below by the foot, and in our potteries a laborer drives it with a wheel and band, but the principle remains unchanged. As we watch with untiring pleasure the potter with this simple machine so easily bringing shape out of shapelessness, we can well understand how in the ancient world it seemed the very type of creation, so that the Egyptians pictured one of their deities as a potter molding man on the wheel.—TYLOR *Anthropology,* ch. 11, p. 274. (A., 1899.)

2651. POTTERY, PRIMITIVE — *The Work of Woman—Made To Meet the Demand for Cooking.*—Women were the first ceramic artisans and developed all the technic, the forms, and the uses of pottery. The inventions concerned in this industrial progress are far-reaching in their own extent, in the influence which they have had in the refinement and development of women, and in the rewards of happiness which they brought to the races and tribes favored by their presence. . . . Pottery or earlier substitutes therefor had no place in the kitchen until the mush-making or meat-seething stage of cookery had arrived.—MASON *Woman's Share in Primitive Culture,* ch. 5, p. 91. (A., 1894.)

2652. ——— ——— *Once Made by Women, Still Made for Women.*—Long ago women made pottery for themselves to wear out and only a little for the convenience or delight of men. The very first woman that made pottery, perhaps, set the vessel on her head and went to the spring for water. A procession of women have been walking about over the earth ever since with jars on their heads. This first woman used another jar to cook food and another to serve it, and another to keep it clean and away from vermin and insects. Pray, what are millions of her great-grandchildren doing this very day but the selfsame things? It matters not who makes pottery, they are making it for women. Their convenience alone is consulted in its form, its temper and material. Its decorations are borrowed, and, tho her hands be no longer grimed with the paste, her wants and her imagination preside over the wheel.—MASON *Woman's Share in Primitive Culture,* ch. 5, p. 113. (A., 1894.)

2653. POVERTY AND THE STARS—*Enthusiasm for Science—A Life Course Changed.*—It was not without a struggle

that he [Bessel] resolved to exchange the desk for the telescope. His reputation with his employers was of the highest; he had thoroughly mastered the details of the business, which his keen, practical intelligence followed with lively interest; his years of apprenticeship were on the point of expiring, and an immediate and not unwelcome prospect of comparative affluence lay before him. The love of science, however, prevailed; he chose poverty and the stars, and went to Lilienthal with a salary of a hundred thalers yearly. Looking back over his life's work, Olbers long afterwards declared that the greatest service which he had rendered to astronomy was that of having discerned, directed, and promoted the genius of Bessel. —CLERKE *History of Astronomy*, pt. i, ch. 2, p. 36. (Bl., 1893.)

2654. POWER ACCOMPANIES COMPLEXITY—*Convolutions Few in Idiot's Brain —Reversion to Animal Type.*—Mr. Marshall has recently examined and described the brains of two idiots of European descent. He found the convolutions to be fewer in number, individually less complex, broader and smoother than in the apes. "In this respect," he says, "the idiots' brains are even more simple than that of the gibbon, and approach that of the baboon." The condition was the result neither of atrophy nor of mere arrest of growth, but consisted essentially in an imperfect evolution of the cerebral hemispheres or their parts, dependent on an arrest of development. The proportion of the weight of brain to that of body was extraordinarily diminished. We learn, then, that when man is born with a brain no higher—indeed, lower—than that of an ape, he may have the convolutions fewer in number, and individually less complex, than they are in the brain of a chimpanzee and an orang; the human brain may revert to or fall below that type of development from which, if the theory of Darwin be true, it has gradually ascended by evolution through the ages.—MAUDSLEY *Body and Mind*, lect. 2, p. 46. (A., 1898.)

2655. POWER, CONSTRUCTIVE, OF LOWER ORGANISMS—*Worms Build Tunnels Lined with Cement.*—The burrows [of earthworms] run down perpendicularly, or more commonly a little obliquely. . . . The walls of fresh burrows are often dotted with little globular pellets of voided earth, still soft and viscid, and these, as it appears, are spread out on all sides by the worm as it travels up or down its burrow. The lining thus formed becomes very compact and smooth when nearly dry, and closely fits the worm's body. The minute reflexed bristles which project in rows on all sides from the body thus have excellent points of support, and the burrow is rendered well adapted for the rapid movement of the animal. The lining appears also to strengthen the walls, and perhaps saves the worm's body from being scratched. I think so because several burrows which passed through a layer of sifted coal-cinders spread over turf to a thickness of 1½ inch, had been thus lined to an unusual thickness. In this case the worms, judging from the castings, had pushed the cinders away on all sides and had not swallowed any of them. In another place burrows similarly lined passed through a layer of coarse coal-cinders 3½ inches in thickness. We thus see that the burrows are not mere excavations, but may rather be compared with tunnels lined with cement. —DARWIN *Formation of Vegetable Mold*, ch. 2, p. 32. (Hum., 1887.)

2656. POWER, ECONOMY OF—*Automatic and Voluntary Actions of the Oyster.* —Look at the empty valve or shell from which you have just removed its tenant [the oyster]. You notice the oval impression on the inside of the valve showing where the muscle was attached, and you observe on the other and companion valve the neighbor impression. Between the two valves of the shell, then, there stretches this strong band of muscular fibers, so strong that it requires the deft hand of the oyster-opener to detach them. This muscle, which closes the valves and keeps them shut, is called the "abductor"; and while our oyster has but one, the mussels themselves possess two. It is a voluntary muscle this of the oyster, and quite as much at the command of the animal as your own biceps is placed under your behest.

But the abductor muscle of the oyster is not an organ which is frequently in use. If the shell is closed by its action, how, you inquire, are the valves opened? Look once again at the empty shell. You observe at its beak or apex the remains of a brownish substance. That is the "ligament" of the shell. It is an elastic band, which is put on the stretch when the shell is closed by the abductor muscle. If that muscle relaxes, you see what will happen. The elastic ligament will come into play, and by that elasticity will keep the shell open.

Now, as an open shell is the oyster's natural condition, we can note in this contrivance a saving of power. The shell is kept unclosed by the purely elastic and mechanical action of the ligament. The oyster has no need to bother itself over this duty. But it is when the more unusual work of closing the shell has to be accomplished that the vital and muscular act comes into play. Then the muscle acts, and "shuts up shop," so to speak, without delay. Nature is always economical in her distribution of power, and our oyster is kept gaping without the expenditure of any vital activity.—WILSON *Glimpses of Nature*, ch. 4, p. 18. (Hum., 1892.)

2657. POWER, ENORMOUS, STORED IN COAL—*Measured by Comparison with Human Labor.*—The most important source of mechanical power among those we have mentioned, and which promises almost to super-

sede all others, is that of burning coal. This material, like a watch wound up, is matter in a state of power, or in a state of unstable equilibrium, ready to rush into combination with the oxygen of the atmosphere as soon as the initial action is given, and to evolve power in the form of heat until the whole is consumed. It has been proved that on an average *four ounces* of coal is sufficient to draw, on a railway, one ton a mile. It has also been found by experiment that a man working on a tread-mill continuously for eight hours will elevate one and a half million of pounds one foot high. Now, good Cornish engines will perform the same work by the expenditure of the power of a pound and a half of coal. It follows from these data that about five tons of coal would evolve as much power during its combustion as would be equal to the continued labor of an able-bodied man for twenty years, at the rate of eight hours per day; or, in other words, to the average power of a man during the active period of his life. Providence has therefore stored away in the form of coal, for the use of man, an incalculable amount of mechanical power. Beneath the soil of our own great coal-basins there reposes power equivalent to the united force of myriads of giants, ready (like Aladdin's genius) to be called into activity by the lamp of science, and as its obedient slave to build cities, to transport palaces, or to remove mountains. There is no other locomotive power over which man has any prospect of control in the least degree comparable with this.—Henry *Improvement of the Mechanical Arts, Scientific Writings,* vol. i, p. 314. (Sm. Inst., 1886.)

2658. POWER, EXPULSIVE — *Comets Shot Forth from Stars—Proved by Parabolic Orbits.*—Every comet or meteor which follows a parabolic orbit possesses a velocity greater than that which the sun's attraction could give it, and it certainly enters the sphere of the solar attraction with a considerable original velocity. There is, then, no other way of explaining the interstellar velocities of comets and hyperbolic bolides but by tracing back their course to the time when their substance was projected from a star with a velocity exceeding by several miles per second that with which a body would reach that star if it had been drawn by gravity alone from an infinite distance.—Flammarion *Popular Astronomy,* bk. v, ch. 3, p. 527. (A.)

2659. POWER, IMPULSIVENESS A SOURCE OF — *Readiness and Promptness Achieve—Contrasted Advantages of the Reflective Character.*—As mental evolution goes on, the complexity of human consciousness grows ever greater, and with it the multiplication of the inhibitions to which every impulse is exposed. But this predominance of inhibition has a bad as well as a good side; and if a man's impulses are in the main orderly as well as prompt, if he has courage to accept their consequences, and intellect to lead them to a successful end, he is all the better for his hair-trigger organization, and for not being "sicklied o'er with the pale cast of thought." Many of the most successful military and revolutionary characters in history have belonged to this simple but quick-witted, impulsive type. Problems come much harder to reflective and inhibitive minds. They can, it is true, solve much vaster problems, and they can avoid many a mistake to which the men of impulse are exposed. But when the latter do not make mistakes, or when they are always able to retrieve them, theirs is one of the most engaging and indispensable of human types.—James *Psychology,* vol. ii, ch. 26, p. 538. (H. H. & Co., 1899.)

2660. POWER LOST IN TRANSMISSION—*Reflection of Light Only Partial.*—In all cases where the light is incident from air upon the surface of a solid or a liquid, or, more generally still, when the incidence is from a less highly refracting to a more highly refracting medium, the reflection is *partial.* In this case the most powerfully reflecting substances either transmit or absorb a portion of the incident light. At a perpendicular incidence water reflects only 18 rays out of every 1,000; glass reflects only 25 rays, while mercury reflects 666. When the rays strike the surface obliquely the reflection is augmented. At an incidence of 40°, for example, water reflects 22 rays, at 60° it reflects 65 rays, at 80° 333 rays; while at an incidence of 89½°, where the light almost grazes the surface, it reflects 721 rays out of every 1,000. Thus, as the obliquity increases, the reflection from water approaches and finally quite overtakes the reflection from mercury; but at no incidence, however great, when the incidence is from air, is the reflection from water, mercury, or any other substance *total.*—Tyndall *Lectures on Light,* lect. 1, p. 17. (A., 1898.)

2661. POWER, MECHANICAL, IN THE SUN'S RAYS — *The Noontide Sunshine of Manhattan Would Drive All the Engines of the World.*—From recent measures it appears that from every square yard of the earth exposed perpendicularly to the sun's rays, in the absence of an absorbing atmosphere, there could be derived more than one horse-power, if the heat were all converted into this use, and that even on such a little area as the island of Manhattan, or that occupied by the city of London, the noontide heat is enough, could it all be utilized, to drive all the steam-engines in the world. It will not be surprising, then, to hear that many practical men are turning their attention to this as a source of power, and that, tho it has hitherto cost more to utilize the power than it is worth, there is reason to believe that some of the greatest changes which civilization has to bring may

yet be due to such investigations.—LANGLEY *New Astronomy*, ch. 4, p. 111. (H. M. & Co., 1896.)

2662. POWER NOT PRODUCED BY MACHINE—*The Craze of Perpetual Motion.*—It was an old notion that power could be gained by machinery, and many men have spent years of time as well as fortunes in pursuing this will-o'-the-wisp, which, if true, would enable us to construct a machine that would propel itself. From their standpoint an animal or a man seemed to be a realization of a perpetual motion. They did not take into account the fact that the food which an animal eats and the air that it breathes sustain the relation, in a sense, to animal locomotion that coal burned under a boiler does to the propulsion of a steam-engine. In both cases there is oxidation caused by the union of oxygen with the carbon, the result of which is the production of heat. Many ingenious automatons were constructed that would simulate the movements of men and animals in the performance of certain kinds of work; and their ingenious constructors had in view the solution of a greater problem than that of the construction of a mere mechanical toy.—ELISHA GRAY *Nature's Miracles*, vol. ii, ch. 2, p. 23. (F. H. & H., 1900.)

2663. POWER NOT PROPORTIONED TO SIZE—*Bacteria Inconceivably Minute.*—This [the coccus] is the group of round cells They vary in size as regards species and as regards the conditions, artificial or natural, under which they have been grown. Some are less than $\frac{1}{15000}$ of an inch in diameter; others are half as large again, if the word "large" may be used to describe such minute objects. No regular standard can be laid down as reliable with regard to their size. Hence the subdivisions of the cocci are dependent not upon the individual elements so much as upon the relation of those elements to each other.—NEWMAN *Bacteria*, ch. 1, p. 8. (G. P. P., 1899.)

2664. POWER OF ADAPTATION—*What is a "Common Plant"?*—"What," said Professor Lindley, fifty years ago, "is a 'common' plant but one which can grow and propagate itself in almost any kind of soil, and under almost every range of temperature; and what is a 'rare' plant but one which cannot flourish and produce seed, except under certain special conditions?" Every botanist knows that among our own wild plants, *Rosa*, *Rubus*, and *Salix* are alike the most "variable" and the most "common" types; "common," because they have the capacity for adapting themselves to different conditions of growth; "variable," because of the influence of those varying conditions upon their organization. Out of the forms of rose, bramble, and willow, ranked as "varietal" by Mr. Bentham, our ablest student of them, previous systematists had created more than three hundred "species."—CARPENTER *Nature and Man*, lect. 15, p. 437. (A., 1889.)

2665. POWER OF A GREAT TEACHER—*Work of Agassiz in America—Influence Long Enduring.*—With the possible exception of the elder Silliman, the influence of Louis Agassiz on the development of science in our country has been greater than that of any other single man. . . . The son of a Protestant clergyman, he was born in Switzerland in 1807, and his early academic education was obtained in Bienne, Lausanne, and Zurich, whence he passed to the great German universities of Heidelberg, Munich, and Erlangen. Even in those days he was a leader. . . . In 1846 an invitation to deliver a course of lectures before the Lowell Institute in Boston was obtained for him through the interest of his friend, Sir Charles Lyell, and he agreed, with Mr. John A. Lowell, to give a course of lectures on the "Plan of the Creation," especially in the animal kingdom. He arrived in Boston in October, and in December delivered his first lecture. "He carried his audience captive." . . . Enthusiastic audiences greeted him in New York, Philadelphia, Charleston, and elsewhere, and yielding to the irresistible opportunities offered to him he severed the ties that bound him to the land of his birth, and accepted the chair of zoology and geology in the Lawrence Scientific School.

Guyot, his friend from boyhood, in speaking of the immense power he exerted in this country in spreading the taste for natural science and elevating the standard, says:

"How many leading students of Nature are found to call themselves his pupils, and gratefully acknowledge their great indebtedness to his judicious training? How many who now occupy scientific chairs in our public institutions multiply his influence by inculcating his methods, thus rendering future success sure."

In this connection I want to quote from a letter of one of his students who wrote me concerning his teaching as follows:

"The ideal of a young scientific student, and of every great teacher, is a devotion to scientific research for its own sake. Agassiz had that ideal extraordinarily developed, and on that account the student was drawn to him and felt in a corresponding degree a great influence on his life. Agassiz made many and important contributions to science, but the greatest of all was a life which embodied the ideal that scientific research is an unselfish study of truth for truth's sake. Every student who was brought in contact with Agassiz recognized this ideal, and was profoundly influenced by it."

The Museum of Comparative Zoology in Cambridge is his most conspicuous monument, but his influence, more powerful than bricks or mortar, will live forever.

A boulder from the glacier of the Aar marks his last resting-place in Mount Au-

burn, and so "the land of his birth and the land of his adoption are united in his grave." — MARCUS BENJAMIN *Early Presidents of the American Association (Proceedings of Amer. Assoc. for the Advancement of Science, 1899).*

2666. POWER OF AIR-CURRENTS—*Birds and Insects Blown off Shore—Insects Borne to Mountain-tops.*—Small singing birds, and even butterflies (as I have myself witnessed in the Pacific), are often met with at great distances from the shore during storms blowing off land. In a similar manner insects are involuntarily carried into the higher regions of the atmosphere, to an elevation of 17,000 to 19,000 feet above the plains. The light bodies of these insects are borne upwards by the vertically ascending currents of air caused by the heated condition of the earth's surface. M. Boussingault, an admirable chemist, who ascended the Gneiss Mountains of Caracas, while holding the appointment of Professor in the newly established Mining Academy at Santa Fé de Bogotá, witnessed, during his ascent to the summit of the Silla, a phenomenon which confirmed in a most remarkable manner this vertical ascent of air. He and his companion, Don Mariano de Rivero, observed at noon a number of luminous, whitish bodies rise from the valley of Caracas to the summit of the Silla, an elevation of 5,755 feet, and then sink towards the adjacent seacoast. This phenomenon was uninterruptedly prolonged for a whole hour, when it was discovered that the bodies, at first mistaken for a flock of small birds, were a number of minute balls of grass-haulm. Boussingault sent me some of this grass, which was immediately recognized by Professor Kunth as a species of *Vilfa.*—HUMBOLDT *Views of Nature*, p. 232. (Bell, 1896.)

2667. POWER OF CONTROLLED INTENSITY—*Impulsiveness Easy.*—The highest form of character, however, abstractly considered, must be full of scruples and inhibitions. But action, in such a character, far from being paralyzed, will succeed in energetically keeping on its way, sometimes overpowering the resistances, sometimes steering along the line where they lie thinnest. . . . The mind of him whose fields of consciousness are complex, and who, with the reasons for the action, sees the reasons against it, and yet, instead of being palsied, acts in the way that takes the whole field into consideration—such a mind is the ideal sort of mind that we should seek to reproduce in our pupils. Purely impulsive action, or action that proceeds to extremities regardless of consequences, on the other hand, is the easiest action in the world and the lowest in type. —JAMES *Talks to Teachers*, ch. 15, p. 179. (H. H. & Co., 1900.)

2668. POWER OF ELEMENTAL FORCES — *Nature's Glassmaking — Fulgurites — Man's Imitations Feeble.*—In a broad band of sand-hillocks [near the Rio Plata] . . . I found a group of those vitrified, siliceous tubes which are formed by lightning entering loose sand. These tubes resemble in every particular those from Drigg, in Cumberland, . . . one of which was traced to a depth of not less than thirty feet. The internal surface is completely vitrified, glossy, and smooth. . . . Their circumference is about two inches, but in some fragments, which are cylindrical and without any furrows, it is as much as four inches. . . . At Paris M. Hachette and M. Beudant succeeded in making tubes, in most respects similar to these fulgurites, by passing very strong shocks of galvanism through finely-powdered glass. . . . One tube, formed with pounded glass, was very nearly an inch long, namely, .982, and had an internal diameter of .019 of an inch. When we hear that the strongest battery in Paris was used, and that its power on a substance of such easy fusibility as glass was to form tubes so diminutive, we must feel greatly astonished at the force of a shock of lightning which, striking the sand in several places, has formed cylinders, in one instance of at least thirty feet long, and having an internal bore, where not compressed, of full an inch and a half; and this in a material so extraordinarily refractory as quartz!—DARWIN *Naturalist's Voyage around the World*, ch. 3, p. 58. (A., 1898.)

2669. POWER OF EVIL DEPENDENT ON WHAT IT FINDS—*Bacteria Produce Disease in Disordered System.*—It has been known for some time past that not all waters polluted with disease-germs produce disease. . . . This may depend upon the infective agent, its quantity and quality, the body being able in many cases to resist a small dose of poison. It is, however, necessary to infection, especially in water-borne disease, that the tissues shall be in some degree disordered. The perverted action of the stomach influences the acid secretion of the gastric juice, through which bacilli might then pass uninjured. Particularly must this be so in the bacillus of cholera, which is readily killed by the normal acid reaction of the stomach.—NEWMAN *Bacteria*, ch. 2, p. 83. (G. P. P., 1899.)

2670. POWER OF EXPANSION—*Bunker Hill Monument Bent by Sunshine.*—Every day when the sun shines the top of Bunker Hill monument is thrown out of plumb several inches by the power of expansion. The same is true of any tower or shaft constructed in the same way. The side that the sun's rays fall upon is expanded, while the opposite remains practically the same. All the molecules on the sunny side are thrown into greater activity, and . require more space in which to move. This causes the column to bend away from the sun in the form of a curve.—ELISHA GRAY *Nature's Miracles*, vol. ii, ch. 14, p. 120. (F. H. & H., 1900.)

2671. POWER OF EXPECTANT ATTENTION—*Officer Awakes at the Word "Signal."*—The following remarkable example . . . was mentioned to the writer by the late Sir Edward Codrington:

When a young man, he was serving as signal-lieutenant under Lord Hood at the time of the investment of Toulon; and being desirous of obtaining the favorable notice of his commander, he applied himself to his duty—that of watching for signals made by the "lookout" frigates—with such energy and perseverance that he often remained on deck eighteen or nineteen hours out of the twenty-four, going below only to sleep. During the few hours which he spent in repose his slumber was so profound that no noise of an ordinary kind, however loud, would awake him, and it used to be a favorite amusement with his comrades to try various experiments devised to test the soundness of his sleep. But if the word "signal" was even whispered in his ear he was instantly aroused, and was fit for immediate duty, the constant direction of his mind towards this one object having given to the impression produced by the softest mention of its name a power over his brain which no other could exert.

It seems impossible to account for these facts in any other way than by attributing to the nerve-centers a peculiar physical receptivity for impressions of some particular class, which they have acquired in virtue of the previous direction of the mind to them. —CARPENTER *Mental Physiology*, bk. ii, ch. 15, p. 582. (A., 1900.)

2672. POWER OF FLIGHT LOST BY DISUSE—*Wingless Moths, Flies, and Beetles.* —Kerguelen Island . . . was visited by the transit of Venus expedition. It is one of the stormiest places on the globe, being subject to almost perpetual gales, while, there being no wood, it is almost entirely without shelter. The Rev. A. E. Eaton, an experienced entomologist, was naturalist to the expedition, and he assiduously collected the few insects that were to be found. All were incapable of flight, and most of them entirely without wings. They included a moth, several flies, and numerous beetles. As these insects could hardly have reached the islands in a wingless state, even if there were any other known land inhabited by them—which there is not—we must assume that . . . they were originally winged, and lost their power of flight because its possession was injurious to them.—WALLACE *Darwinism*, ch. 5, p. 74. (Hum.)

2673. POWER OF GOOD INVOLVES CAPACITY OF FAILURE—*The Automaton Sure, but Helpless.*—A high brain may do many things, and may do each of them at a very slight hint. But its hair-trigger organization makes of it a happy-go-lucky, hit-or-miss affair. It is as likely to do the crazy as the sane thing at any given moment. A low brain does few things, and in doing them perfectly forfeits all other use. —JAMES *Psychology*, vol. i, ch. 5, p. 140. (H. H. & Co., 1899.)

2674. POWER OF GROWTH—*Growing Root Divides Earth, as Wooden Wedge Splits Rock.*—With these facts before us, there seems little difficulty in understanding how a radicle penetrates the ground. The apex is pointed and is protected by the root-cap; the terminal growing part is rigid and increases in length with a force equal, as far as our observations can be trusted, to the pressure of at least a quarter of a pound, probably with a much greater force when prevented from bending to any side by the surrounding earth. Whilst thus increasing in length it increases in thickness, pushing away the damp earth on all sides, with a force of above 8 pounds in one case, of 3 pounds in another case. It was impossible to decide whether the actual apex exerts, relatively to its diameter, the same transverse strain as the parts a little higher up; but there seems no reason to doubt that this would be the case. The growing part, therefore, does not act like a nail when hammered into a board, but more like a wedge of wood, which whilst slowly driven into a crevice continually expands at the same time by the absorption of water; and a wedge thus acting will split even a mass of rock.—DARWIN *Power of Movement in Plants*, ch. 2, p. 78. (A., 1900.)

2675. POWER OF HABIT—*Automatic Action—Without Reflection or Even Consciousness Accomplishes the Ends of Volition.*—Actions originally prompted by conscious intelligence may grow so automatic by dint of habit as to be apparently unconsciously performed. Standing, walking, buttoning and unbuttoning, piano-playing, talking, even saying one's prayers, may be done when the mind is absorbed in other things. The performances of animal *instinct* seem semi-automatic, and the *reflex acts* of self-preservation certainly are so. Yet they resemble intelligent acts in bringing about the *same ends* at which the animal's consciousness, on other occasions, deliberately aims.—JAMES *Psychology*, vol. i, ch. 1, p. 5. (H. H. & Co., 1899.)

2676. POWER OF HIGHER FACULTIES—*More Persistent than That of Lower—Intellect Rallies from Shock before Sense-perception.*—Under ordinary circumstances the discharge from a small Leyden jar is exceedingly unpleasant to me. Some time ago I happened to stand in the presence of a numerous audience, with a battery of fifteen large Leyden jars charged beside me. Through some awkwardness on my part I touched a wire leading from the battery, and the discharge went through my body. Life was absolutely blotted out for a very sensible interval, without a trace of pain. In a second or so consciousness returned;

I vaguely discerned the audience and apparatus, and by the help of these external appearances immediately concluded that I had received the battery discharge. The *intellectual* consciousness of my position was restored with exceeding rapidity, but not so the *optical* consciousness. To prevent the audience from being alarmed I observed that it had often been my desire to receive accidentally such a shock, and that my wish had at length been fulfilled. But while making this remark the appearance which my body presented to my eyes was that of a number of separate pieces. The arms, for example, were detached from the trunk, and seemed suspended in the air. In fact, memory and the power of reasoning appeared to be complete long before the optic nerve was restored to healthy action.—TYNDALL *Fragments of Science*, vol. i, ch. 21, p. 442. (A., 1900.)

2677. POWER OF MIND OVER BODY—*Pain from Imaginary Wound.*—"A butcher was brought into the shop of Mr. Macfarlan, the druggist, from the market-place opposite, laboring under a terrible accident. The man, on trying to hook up a heavy piece of meat above his head, slipped, and the sharp hook penetrated his arm, so that he himself was suspended. On being examined he was pale, almost pulseless, and expressed himself as suffering acute agony. The arm could not be moved without causing excessive pain, and in cutting off the sleeve he frequently cried out; yet when the arm was exposed, it was found to be quite uninjured, the hook having only traversed the sleeve of his coat."—BENNET *The Mesmeric Mania of 1851*, quoted by CARPENTER in *Nature and Man*, bk. i, ch. 4, p. 158. (A., 1900.)

2678. POWER OF MUSCLES INSTANTLY AVAILABLE—*Tension Maintained in Rest.*—During rest or inactivity a muscle has a slight but very perfect elasticity; it admits of being considerably stretched, but returns readily and completely to its normal length. In the living body the muscles are always stretched somewhat beyond their natural length; they are always in a condition of slight tension, an arrangement which enables the whole force of the contraction to be utilized in approximating the points of attachment. It is obvious that if the muscles were lax the first part of the contraction till the muscle became tight would be wasted.—BAKER *Handbook of Physiology*, vol. ii, ch. 15, p. 22. (W. W., 1885.)

2679. POWER OF QUIET PROCESS—*Simmering Water Cooks Food Effectually.*—As a medium for heating the substances to be cooked, simmering water is just as effective as "walloping" water. There are exceptional operations of cookery, wherein useful mechanical work is done by violent boiling; but in all ordinary cookery simmering is just as effective. The heat that is applied to do more than the smallest degree of simmering is simply wasted in converting water into useless steam. The amount of such waste may be easily estimated. To raise a given quantity of water from the freezing- to the boiling-point demands an amount of heat represented by 180° in Fahrenheit's thermometer, or 100° centigrade. To convert this into steam 990° F., or 550° C., is necessary—just five and a half times as much.—WILLIAMS *Chemistry of Cookery*, ch. 2, p. 15. (A., 1900.)

2680. ——— ——— *The Spring vs. the Volcano.*—Altho the violent and paroxysmal outbursts of volcanic mountains arrest the attention, and powerfully impress us with a sense of the volcanic activity going on beneath the earth's surface, yet it may well be doubted whether the quantity of heat which the earth gets rid of by their means at all approaches in amount that which is quietly dissipated by means of the numerous "stufas," gaseous exhalations, and thermal springs which occur in such abundance all over its surface. For while the former are intermittent in their action, and powerful outbursts are interrupted by long periods of rest, the action of the latter, tho feeble, is usually continuous.—JUDD *Volcanoes*, ch. 8, p. 218. (A., 1899.)

2681. POWER OF SLOW-MOVING MASS—*Glacier Plows Away Hill.*—The snout of a glacier is potent to remove anything against which it can fairly abut; and this power, notwithstanding the slowness of the motion, manifests itself at the end of the Morteratsch glacier. A hillock, bearing pine-trees, was in front of the glacier when Mr. Hirst and myself inspected its end, and this hillock is being bodily removed by the thrust of the ice. Several of the trees are overturned, and in a few years, if the glacier continues its reputed advance, the mound will certainly be plowed away.—TYNDALL *Fragments of Science*, ch. 9, p. 249. (A., 1897.)

2682. POWER OF THE INVISIBLE—*Energy of Molecules—Their Rebound Turns the Radiometer.*—The radiometer, to be seen in almost every optician's window, was invented by Sir William Crookes in 1873, and consists of an exceedingly delicate windmill, formed of four very slender arms supporting thin metal or pith disks, one side of which is blackened, the whole turning on a fine central point, so as to revolve with hardly any friction. The little machine is enclosed in a glass bulb from which nearly all the air has been extracted; and when exposed to the sun, or even to diffused daylight, the disks revolve with considerable speed. At first this motion was supposed to be caused by the direct impact of the rays of light, the almost complete vacuum only serving to diminish friction; but the explanation now generally adopted is that the black surfaces of the vanes, absorbing heat, become slightly

warmer than the white surfaces, and this greater warmth is communicated to the air-molecules, and causes them to rebound with greater rapidity from the dark surfaces and back again from the glass of the vessel, and the reaction, being all in one direction, causes the arms to revolve. The near approach to a vacuum is necessary, both to diminish resistance, and by greatly reducing the number of molecules in the vessel, to allow the very small differential action to produce a sensible effect. Sir William Crookes has found that there is a degree of rarefaction where the action is at a maximum, and that when a nearer approach to a perfect vacuum is attained the motion rapidly diminishes. A proof is thus given of the correctness of the explanation, and the instrument may, therefore, be considered to afford us an experimental illustration of the molecular theory of gases.—WALLACE *The Wonderful Century*, ch. 8, p. 59. (D. M. & Co., 1899.)

2683. ——— ——— *Heat-waves Contrasted with Rays of Light.*—Besides those which produce light, the sun sends forth incessantly a multitude of waves which produce no light. The largest waves which the sun sends forth are of this non-luminous character, tho they possess the highest heating power.

A common sunbeam contains waves of all kinds, but it is possible to sift or filter the beam so as to intercept all its light, and to allow its obscure heat to pass unimpeded. For substances have been discovered which, while intensely opaque to the light-waves, are almost perfectly transparent to the others. On the other hand, it is possible, by the choice of proper substances, to intercept in a great degree the pure heat-waves, and to allow the pure light-waves free transmission. . . . Supposing, then, that we withdraw, in the first instance, the large heat-waves and allow the light-waves alone to pass. These may be concentrated by suitable lenses and sent into water without sensibly warming it. Let the light-waves now be withdrawn and the larger heat-waves concentrated in the same manner; they may be caused to boil the water almost instantaneously. . . . The light-waves, even when concentrated to the uttermost, are unable to melt the most delicate hoar-frost.—TYNDALL *Forms of Water*, p. 12. (A., 1899.)

2684. ——— ——— *The Sun's Attractive Energy.*—The sun, besides sustaining us by his light-giving and heat-supplying powers, keeps us always near to him by that mighty force of attraction which his vast bulk enables him to exert. When we look at the sun as he rises (even as "the glory of God coming from the way of the east") how seldom is the thought present in our minds that in that ruddy orb there exists the most tremendous power, swaying not only this vast globe on which we live, but orbs yet vaster than she is and traveling on far wider courses.—PROCTOR *Expanse of Heaven*, ch. 2, p. 13. (L. G. & Co., 1897.)

2685. ——— ——— *Transporting Action of the Wind—Granite Cliffs Blown Away.*—The transporting action of the wind, or "deflation," as it is termed, goes on without ceasing day and night and during all seasons; and the result is seen in the deeply eroded rocks, enormous masses of which, it can be shown, have been thus gradually removed. The evidence of denudation is conspicuous, but its products have for the most part been carried away. In some places, as Professor Walther remarks of the Libyan Desert, are great walls of granite rising to heights of 6,000 feet, but showing no slopes of débris below, as would infallibly be present under temperate conditions of climate. In other places, again, are deeply excavated wadies containing no beds of gravel, grit, and sand, such as would not fail to show themselves had the depressions in question been formed by water-action alone. Everywhere deep, cavelike hollows have been worn out in the rocks, and yet these hold no sediment or detritus, but are swept bare. The wind tends, in short, to transport all loose material from the scene of its origin to the borders of the desert.—GEIKIE *Earth Sculpture*, ch. 2, p. 24. (G. P. P., 1898.)

2686. ——— ——— *Unseen Rays of Spectrum Rich in Heat.*—The great pioneer in this domain of science [the study of radiation] was Sir William Herschel. Causing a beam of solar light to pass through a prism, he resolved it into its colored constituents; he formed what is technically called the solar spectrum. Exposing thermometers to the successive colors, he determined their heating power, and found it to augment from the violet or most refracted end to the red or least refracted end of the spectrum. But he did not stop here. Pushing his thermometers into the dark space beyond the red, he found that, tho the light had disappeared, the radiant heat falling on the instruments was more intense than that at any visible part of the spectrum. In fact, Sir William Herschel showed, and his results have been verified by various philosophers since his time, that, besides its luminous rays, the sun pours forth a multitude of other rays, more powerfully calorific than the luminous ones, but entirely unsuited to the purposes of vision.—TYNDALL *Fragments of Science*, ch. 2, p. 32. (A., 1897.)

2687. ——— ——— *Unseen Rays of Spectrum Yield Chemical Energy, as Well as Heat.*—At the less refrangible end of the solar spectrum, then, the range of the sun's radiation is not limited by that of the eye. The same statement applies to the more refrangible end. Ritter discovered the extension of the spectrum into the invisible region beyond the violet, and in recent times this

ultraviolet emission has had peculiar interest conferred upon it by the admirable researches of Professor Stokes. The complete spectrum of the sun consists, therefore, of three distinct parts: first, of ultrared rays of high heating power, but unsuited to the purposes of vision; secondly, of luminous rays which display the succession of colors, red, orange, yellow, green, blue, indigo, violet; thirdly, of ultraviolet rays which, like the ultrared ones, are incompetent to excite vision, but which, unlike the ultrared rays, possess a very feeble heating power. In consequence, however, of their chemical energy these ultraviolet rays are of the utmost importance to the organic world.—TYNDALL *Fragments of Science*, ch. 2, p. 32, (A., 1897.)

2688. POWER OF THE SUN—*Greater than the Conjectures of Its Ancient Worshipers.*—At the return of the equinox the rising of the sun, the god of day, the king of light, was saluted by the Incas from the heights of their cyclopean terraces. The same adoration, the same worship, is met with among all the ancient peoples. Without yet taking into account the real size and the incomparable importance of the dazzling star, they already knew that he is the father of terrestrial Nature; they knew that it is his heat which supports life; they knew that it is he who makes the trees in the forests to grow, the stream to flow in the valley, the flowers of the meadow to bloom, the bird to sing in the wood, the cereals and the vines to ripen, and they hailed in him their father, their friend, and their protector.

Modern science has not only confirmed but increased tenfold, a hundredfold, the ancient conjectures. The sun's light, heat, and power are as much above the ancient ideas as the poetry of Nature is above our interpretation. No light created by human industry can be compared with his. Interposed before his disk, the brilliant electric light appears black. The highest temperatures of our furnaces, that of the melting of gold, of silver, of platinum, of iron, are but ice compared with the solar heat.—FLAMMARION *Popular Astronomy*, bk. iii, ch. 3, p. 243. (A.)

2689. POWER OF TWINING OR CLIMBING INNATE—*Wonderful Adaptations.*—That the movements of climbing plants consist of ordinary circumnutation, modified by being increased in amplitude, is well exhibited whilst the plants are very young; for at this early age they move like other seedlings, but as they grow older their movements gradually increase without undergoing any other change. That this power is innate, and is not excited by any external agencies, beyond those necessary for growth and vigor, is obvious. No one doubts that this power has been gained for the sake of enabling climbing plants to ascend to a height, and thus to reach the light. This is effected by two very different methods—first by twining spirally round a support, but to do so their stems must be long and flexible; and secondly, in the case of leaf-climbers and tendril-bearers, by bringing these organs into contact with a support, which is then seized by the aid of their sensitiveness. It may be here remarked that these latter movements have no relation, as far as we can judge, with circumnutation. In other cases the tips of tendrils, after having been brought into contact with a support, become developed into little disks which adhere firmly to it.—DARWIN *Power of Movement in Plants*, ch. 5, p. 267. (A., 1900.)

2690. POWER OF UNAIDED VISION—*May Even Surpass Telescope—Visibility of Distant Objects—White on Black More Distinct than Black on White.*—During my visit at a charming country-seat . . . not far from Quito, where the long-extended crests of the volcano of Pichincha lay stretched before me at a horizontal distance trigonometrically determined at more than 90,000 feet, I was much struck by the circumstance that the Indians who were standing near me distinguished the figure of my traveling companion Bonpland (who was engaged in an expedition to the volcano) as a white point moving on the black basaltic sides of the rock, sooner than we could discover him with our telescopes. The white moving image was soon detected with the naked eye both by myself and by my friend. . . . Bonpland was enveloped in a white cotton mantle, the poncho of the country; assuming the breadth across the shoulders to vary from three to five feet, according as the mantle clung to the figure or fluttered in the breeze, and judging from the known distance, we found that the angle at which the moving object could be distinctly seen varied from 7″ to 12″. White objects on a black ground are, according to Hueck's repeated experiments, distinguished at a greater distance than black objects on a white ground. . . . Gauss's heliotrope light, which has become so important an element in German trigonometrical measurements, has been seen with the naked eye reflected from the Brocken on Hohenhagen, at a distance of about 227,000 feet, or more than 42 miles.—HUMBOLDT *Cosmos*, vol. iii, p. 55. (H., 1897.)

2691. POWER, PHILOSOPHIC, COMBINED WITH MEMORY—If . . . we consider the brain to be the organic condition by which the vestiges of our experience are associated with each other, we may suppose that some brains are "wax to receive and marble to retain." The slightest impressions made on them abide. Names, dates, prices, anecdotes, quotations, are indelibly retained, their several elements fixedly cohering together, so that the individual soon becomes a walking cyclopedia of information. . . . And when both memory

and philosophy combine together in one person, then, indeed, we have the highest sort of intellectual efficiency. Your Walter Scotts, your Leibnitzes, your Gladstones, and your Goethes, all your folio copies of mankind, belong to this type. Efficiency on a colossal scale would indeed seem to require it. For, altho your philosophic or systematic mind without good, desultory memory may know how to work out results and recollect where in the books to find them, the time lost in the searching process handicaps the thinker, and gives to the more ready type of individual the economical advantage.—JAMES *Talks to Teachers*, ch. 12, p. 120. (H. H. & Co., 1900.)

2692. POWER STORED IN COAL-FIELDS—*Millions of Horses Could Not Equal.*—We dig annually 84 millions of tons of coal from our pits. The amount of mechanical force represented by this quantity of coal seems perfectly fabulous. The combustion of a single pound of coal, supposing it to take place in a minute, would be equivalent to the work of 300 horses; and if we suppose 108 millions of horses working day and night with unimpaired strength for a year, their united energies would enable them to perform an amount of work just equivalent to that which the annual produce of our coal-fields would be able to accomplish.—TYNDALL *Fragments of Science*, vol. i, ch. 16, p. 373. (A., 1897.)

2693. POWER UNDESIRABLE WITHOUT BENEFICENCE—A cold and inert mass of matter, however, would be able to do all that the sun does by his mere mass, and yet be utterly unfit to be, like him, the ruler over a scheme of circling worlds. The glory of the sun is not in his strength alone. As Sir John Herschel has well said, "Giant size and giant strength are ugly qualities without beneficence." But the sun is the almoner of the Almighty, the delegated dispenser to us of light and warmth, as well as the center of attraction.—PROCTOR *Expanse of Heaven*, ch. 2, p. 15. (L. G. & Co., 1897.)

2694. POWERS, MECHANICAL, ALL USED BY PRIMITIVE MAN—The mechanical powers, in the order of their simplicity, are the *inclined plane*, the *wedge*, *lever*, the *roller*, the *pulley*, the *wheel and axle*, and the *screw*. These devices for converting time and weight and velocity into momentum, and for changing the direction and character of momentum, are at the foundation of the modern intricate machinery. But the simplest forms of all these useful things were elaborated by primitive mechanics with what little suggestion they could get from the animal world. The inclined plane, both for rolling and sliding friction, as well as for convenience in walking, is too easy to dwell upon. The Eskimo sledge men, the hunter dragging his game, the fishermen on a sloping beach landing a great sea monster or a canoe, the Indians of the cañons making a trail, the Caribs launching a pirogue, the mound-builders or the Mexicans ascending a great ceremonial earthwork, were equally skilled in selecting a gentle slope or in making one. The natives of British Columbia make skids of stout saplings, and on them roll up the logs that are to form the plate pieces of their communal dwellings, holding them in position by means of shore poles. The great stone buildings of Mexico, Central America, and Peru were the work of men's hands, with no aid from animals or natural powers. The invariable association of all such structures with sloping earthworks and pyramids points to the chief mechanical power known to the builders. An additional value is given to the inclined plane in that it allows the cooperation of as many individuals as are necessary, and it also lends itself to cooperation with the other powers. The wedge was in universal use among the American native mechanics. . . . The wedges were always made of the hardest material known in any region. Wood, ivory, elkhorn, bone, and even hammered copper did service.—MASON *Aboriginal American Mechanics (Memoirs of the International Congress of Anthropology*, p. 74). (Sch. P. C.)

2695. POWERS, MECHANICAL, ANTEDATE HISTORY—*The Lever, Roller, Inclined Plane, and Pulley Known in Ancient Egypt.*—As to how simple mechanical powers were first learned, it is of no use to guess in what rude and early age men found that stones or blocks too weighty to lift by hand could be prized up and moved along with a stout stick, or rolled on two or three round poles, or got up a long, gentle slope more easily than up a short, steep rise. Thus such discoveries as those of the lever, roller, and inclined plane are quite out of historical reach. The ancient Egyptians used wedges to split off their huge blocks of stone, and one wonders that, knowing the pulleys as they did, it never appears in the rigging of their ships. . . . A draw-well, with a pulley, is to be seen in the Assyrian sculptures, where also a huge winged bull is being heaved along with levers, and dragged on a sledge with rollers laid underneath.—TYLOR *Anthropology*, ch. 8, p. 198. (A., 1899.)

2696. POWERS, UNUSED, PERISH—*The Eyes of the Mole Atrophied—Blind Fishes in Caves.*—There are certain burrowing animals—the mole, for instance—which have taken to spending their lives beneath the surface of the ground. And Nature has taken her revenge upon them in a thoroughly natural way—she has closed up their eyes. If they mean to live in darkness, she argues, eyes are obviously a superfluous function. By neglecting them these animals made it clear they do not want them. And as one of Nature's fixed principles is that nothing shall exist in vain, the eyes are presently taken away, or re-

duced to a rudimentary state. There are fishes also which have had to pay the same terrible forfeit for having made their abode in dark caverns, where eyes can never be required. And in exactly the same way the spiritual eye must die and lose its power by purely natural law if the soul choose to walk in darkness rather than in light.—DRUMMOND *Natural Law in the Spiritual World*, essay 2, p. 99. (H. Al.)

2697. PRACTISE, EFFECT OF—*Machine Runs More Easily by Use—Exertion Secures Increased Supply—Nerve Stimulation More Readily Set Up.*—A movement which takes place again and again in the same direction comes by degrees to follow this direction more readily than any other, and will presently be unaffected by influences which at first would have had no difficulty in diverting it. When water is poured upon the ground it forms a channel for itself. Its initial direction may have been determined by the merest accident, but, once determined, is adhered to, and the more certainly the oftener we pour. When a machine is set in motion there is always the same resistance of mass to be overcome in its various parts; but friction is lessened by the wearing and smoothing of part against part, so that a machine which has been going for some time usually runs more easily than a new one or one which has lain for a long time unused. If you let your watch run down, and do not wind it up for a fortnight, you know that it is always liable to stop until it has been going again for a week or so. Now there is good evidence for the view that the same thing holds of neural processes. If we are in the habit of executing some definite muscular movement we know that it gradually becomes easier—*i. e.*, can be made with less expenditure of force. What we call "practise" consists simply in changes of this sort. The execution of a practised movement becomes easier because the stimulation-process in nerve and muscle is the more easily set up the more frequently it is repeated. This process is originated by an increased supply of the elements essential to the tissues; so that exercised muscles show an increase in the mass of their contractile substance.—WUNDT *Psychology*, lect. 9, p. 144. (Son. & Co., 1896.)

2698. PRACTISE MUST BE SUPPORTED BY THEORY—*Closet Workers Needful to Sustain Industrial Achievement.*—To keep society as regards science in healthy play, three classes of workers are necessary: Firstly, the investigator of natural truth, whose vocation it is to pursue that truth, and extend the field of discovery for the truth's own sake, and without reference to practical ends. Secondly, the teacher of natural truth, whose vocation it is to give public diffusion to the knowledge already won by the discoverer. Thirdly, the applier of natural truth, whose vocation it is to make scientific knowledge available for the needs, comforts, and luxuries of civilized life. These three classes ought to coexist and interact. Now, the popular notion of science, both in this country and in England, often relates not to science strictly so called, but to the applications of science. Such applications, especially on this continent, are so astounding—they spread themselves so largely and umbrageously before the public eye—that they often shut out from view those workers who are engaged in the quieter and profounder business of original investigation.—TYNDALL *Lectures on Light*, lect. 6, p. 219. (A., 1898.)

2699. PRACTISE TRANSFORMS VOLUNTARY INTO AUTOMATIC MOVEMENT—Practise always implies that an action which at first was performed voluntarily has gradually become reflex and automatic. Thus when the child learns to walk, the taking of each single step is accompanied by a considerable effort of will; but after a time and by slow degrees it becomes able to initiate a whole series of movements without attending to their execution in detail. In the same way we learn to play the pianoforte or to execute other complicated movements of the hands by frequent repetition of particular and connected acts, and their consequent transformation into a chain of effects which follow each other with mechanical certainty when once the appropriate impulse has been given. Now the modifications which the nervous system undergoes during the life of the individual, in consequence of the mechanizing of these practised movements, must naturally, like all other modifications of the same kind, be summated and intensified in the course of generations. The purposive character of the reflexes becomes then readily intelligible, if we regard them as resulting from the voluntary action of previous generations.—WUNDT *Psychology*, lect. 15, p. 227. (Son. & Co., 1896.)

2700. PRAYER A UNIVERSAL IMPULSE—*Will Persist Spite of All Discussion.*—We hear, in these days of scientific enlightenment, a great deal of discussion about the efficacy of prayer; and many reasons are given us why we should not pray, whilst others are given us why we should. But in all this very little is said of the reason why we *do* pray, which is simply that we cannot *help* praying. It seems probable that, in spite of all that "science" may do to the contrary, men will continue to pray to the end of time, unless their mental nature changes in a manner which nothing we know should lead us to expect. The impulse to pray is a necessary consequence of the fact that whilst the innermost of the empirical selves of a man is a self of the *social* sort, it yet can find its only adequate *socius* in an ideal world.—JAMES *Psychology*, vol. i, ch. 10, p. 316. (H. H. & Co., 1899.)

2701. PRAYER CANNOT BENEFIT BY FALSE PRETENSE—*Preaching to Oneself under Guise of Praying to God.*—We find many men now facing the consequences to which they have given their intellectual assent, and taking their stand upon the ground that prayer to God has no other value or effect than so far as it may be a good way of preaching to ourselves. It is a useful and helpful exercise for our own spirits, but it is nothing more. But how can they pray who have come to this? Can it ever be useful or helpful to believe a lie? That which has been threatened as the worst of all spiritual evils would then become the conscious attitude of our "religion," the habitual condition of our worship. This must be a bad science, as it is bad religion. It is in violation of a law the highest known to man—the law which inseparably connects earnest conviction of the truth in what we do or say with the very fountains of all intellectual and moral strength. No accession of force can come to us from doing anything in which we disbelieve.—ARGYLL *Reign of Law*, ch. 2, p. 37. (Burt.)

2702. PRECESSION OF THE EQUINOXES—*Changes Wrought during That Long Duration—Transitoriness of Human Life—The Transforming Work of Time.*—Immense and slow revolution of the skies! What events occur on our globe during the course of one of these periods! The last time that the pole occupied the place which it does today, 25,765 years ago, none of the present countries existed. None of the nations who dispute to-day for supremacy on the planet had then left the cradle of Nature. Already, doubtless, there were men upon the earth, but the social unions which they formed have left no trace of the degree of civilization to which they had attained, and it is very probable that these uncultured and savage beings were then in the midst of the primitive Stone Age, of which so many proofs have recently been collected. Where shall we be in our turn when, after another period of equal duration, the pole will have again returned to its present position? French, English, Germans, Italians, Spaniards, may then join hands in a common obscurity. None of our contemporary nations will have resisted the transforming work of time. Other nations, other languages, other religions will have long since replaced the present state of things. One day a traveler wandering on the banks of the Seine will be attracted by a heap of ruins, seeking the place where Paris had, during so many ages, shed its light. Perhaps he will find the same difficulty in recovering places formerly famous that the antiquary now finds in identifying the site of Thebes or of Babylon. Our nineteenth century will be then, in antiquity, very much further back than are for us the ages of the Pharaohs and the ancient Egyptian dynasties. A new human race intellectually superior to ours will have won its way to the sunlight; and we shall perhaps be very surprised, you and I, O studious and thoughtful readers! to meet each other, side by side—blanched and carefully labeled skeletons—installed in a glass case of a museum, by a naturalist of the two hundred and seventy-sixth century, as curious specimens of an ancient race, rather wild, but already endowed with a certain aptitude for the study of the sciences. Vanity of vanities! O noisy ambitions of a day, who pass our life disputing about tinsel, about empty titles and many-colored decorations, ask yourselves what philosophy must think of your ephemeral vainglory when it compares your puerile rivalries with the majestic work of Nature, which bears us all to the same destiny!—FLAMMARION *Popular Astronomy*, bk. i, ch. 4, p. 41. (A.)

2703. PRECIOUS DESTROYED BY WORTHLESS—*Weeds Kill Pasturage.*—The most noxious weed in New Zealand appears, . . . to be the *Hypochœris radicata*, a coarse, yellow-flowered composite not uncommon in our meadows and waste places. This has been introduced with grass seeds from England, and is very destructive. It is stated that excellent pasture was in three years destroyed by this weed, which absolutely displaced every other plant on the ground.—WALLACE *Darwinism*, ch. 2, p. 20. (Hum., 1889.)

2704. PRECIOUSNESS OF LOWLY LIFE—*Biology Values the Humblest.*—It is a well-established fact in biology that the humblest creature is just as important a link in the chain of creation as the highest mammal. The higher forms are so well known, and so little has been found out concerning some of the more lowly creatures, that the naturalist is very glad to leave the ninety-and-nine and go into the wilderness to seek the one that is lost.—MASON *Origins of Invention*, ch. 12, p. 413. (S., 1899.)

2705. PRECIPITATION OF MINERALS KEEPS WATER PURE—*Rocks Now Forming in the Rhone, the Adriatic, and the Mediterranean.*—The Rhone, the Po, the Nile, and many hundred minor streams and springs pour annually into the Mediterranean large quantities of carbonate of lime, together with iron, magnesia, silica, alumina, sulfur, and other mineral ingredients in a state of chemical solution. To explain why the influx of this matter does not alter the composition of this sea has never been regarded as a difficulty; for it is known that calcareous rocks are forming in the delta of the Rhone, in the Adriatic, on the coast of Asia Minor, and in other localities. Precipitation is acknowledged to be the means whereby the surplus mineral matter is disposed of, after the consumption of a certain portion in the secretions of testacea, zoophytes, and other marine animals.—LYELL *Principles of Geology*, bk. ii, ch. 20, p. 335. (A., 1854.)

2706. PRECISION OF SCIENCE—*Minute Exactness of Measurement Led to Discovery of Velocity of Light—The Satellites of Jupiter.*—Römer watched this moon [of Jupiter], saw it move round in front of the planet, pass to the other side of it, and then plunge into Jupiter's shadow, behaving like a lamp suddenly extinguished; at the second edge of the shadow he saw it reappear, like a lamp suddenly lighted. The moon thus acted the part of a signal-light to the astronomer, and enabled him to tell exactly its time of revolution. The period between two successive lightings-up of the lunar lamp he found to be 42 hours, 28 minutes, and 35 seconds. This measurement of time was so accurate that, having determined the moment when the moon emerged from the shadow, the moment of its hundredth appearance could also be determined. In fact, it would be 100 times 42 hours, 28 minutes, 35 seconds after the first observation. Römer's first observation was made when the earth was in the part of its orbit nearest Jupiter. About six months afterwards, the earth being then at the opposite side of its orbit, when the little moon ought to have made its hundredth appearance, it was found unpunctual, being fully 15 minutes behind its calculated time. Its appearance, moreover, had been growing gradually later as the earth retreated towards the part of its orbit most distant from Jupiter. Römer reasoned thus: "Had I been able to remain at the other side of the earth's orbit the moon might have appeared always at the proper instant; an observer placed there would probably have seen the moon 15 minutes ago, the retardation in my case being due to the fact that the light requires 15 minutes to travel from the place where my first observation was made to my present position."

This flash of genius was immediately succeeded by another. "If this surmise be correct," Römer reasoned, "then as I approach Jupiter along the other side of the earth's orbit the retardation ought to become gradually less, and when I reach the place of my first observation there ought to be no retardation at all." He found this to be the case, and thus not only proved that light required time to pass through space, but also determined its rate of propagation. —TYNDALL *Lectures on Light*, lect. 1, p. 20. (A., 1898.)

2707. ——— ——— *Observation Needs Correction by Deeper Knowledge—The Apparent Not the Real.*—Direct observation furnishes only what has been called the "raw material" of the positions of the heavenly bodies. A number of highly complex corrections have to be applied before their mean can be disengaged from their apparent places on the sphere. Of these, the most considerable and familiar is atmospheric refraction, by which objects seem to stand higher in the sky than they in reality do, the effect being evanescent at the zenith, and attaining, by gradations varying with conditions of pressure and temperature, a maximum at the horizon. Moreover, the points to which measurements are referred are themselves in motion, either continually in one direction, or periodically to and fro. The precession of the equinoxes is slowly progressive, or rather retrogressive; the nutation of the pole oscillatory in a period of about eighteen years—added to which, the non-instantaneous transmission of light, combined with the movement of the earth in its orbit, causes a minute displacement known as aberration. Now it is easy to see that any uncertainty in the application of these corrections saps the very foundations of exact astronomy.—CLERKE *History of Astronomy*, pt. i, ch. 2, p. 37. (Bl., 1893.)

2708. ——— ——— *Telegraphic Notation of Time—Buoy of Sunken Cable Found on the High Sea.*—To show what could be done if there were perfect means of determining the time, the following narrative may be cited: When the "Great Eastern" is carrying a telegraph cable across the Atlantic, her captain, of course, knows the true Greenwich time within a single second, for it is flashed to him from Valentia. He can therefore determine his true place with great accuracy. Now it chanced that on one occasion the captain of the "Great Eastern," while thus in telegraphic communication with Greenwich through Valentia, had occasion to search for a buoy which had been left floating (attached to a sunk cable) in a particular latitude and longitude. He made for the spot according to his calculated latitude and longitude, and (according to the account) after the final directions had been given to the effect that the ship should follow a certain course for a certain time he went below to examine a chart. When the time came he was about to go on deck, hoping to have made his course so truly that the buoy would be in sight; but at that very instant the ship's side was struck by the buoy.—PROCTOR *Expanse of Heaven*, p. 34. (L. G. & Co., 1897.)

2709. ——— ——— *Volcanic Dust of Iceland, Fallen in Norway, Identified in Germany.*—We sometimes meet with this far-traveled, volcanic dust under very unexpected circumstances. Thus, in the spring of 1875 I had occasion to visit Professor Vom Rath, of Bonn, who showed me a quantity of fine volcanic dust which had during the past winter fallen in considerable quantities in certain parts of Norway. This dust, upon microscopic examination, proved to be so similar to what was known to be frequently ejected from the Icelandic volcanoes that a strong presumption was raised that volcanic outbursts had been going on in that island. On returning to England I found that the first steamer of the season had just reached Leith from Iceland, bringing the intelligence that very violent erup-

tions had taken place during the preceding months.—JUDD *Volcanoes*, ch. 4, p. 72. (A., 1899.)

2710. PREDICTION OF CONDUCT— *Perfect Knowledge Would Be Perfect Foreknowledge.*—We can predict conduct with almost perfect certainty when we know character with an equal measure of assurance, and when we know the influences to which that character will be exposed. In proportion as we are sure of character, in the same proportion we are sure of conduct. Yet we never think of the will being the less free because we can predict its course. What we know in such cases is simply the use which, under given conditions, will be made of freedom. There is no certainty in the world of physics more absolute than some certainties in the world of mind. We know that a humane man will not do a uselessly cruel action. We know that an honorable man will not do a base action. And if in such cases we are deceived in the result, we know that it is because we were ignorant of some weakness or of some corruption; that is to say, we were ignorant of some elements of character. But we never doubt that if those had been known we could have foreseen the resulting lapse. Perfect knowledge must therefore be perfect foreknowledge. To know the present perfectly is to know the future certainly. To know all that is, is to know all that will be. To know the heart of man completely is to know his conduct completely also; for "out of the heart are the issues of life." So far from this conclusion being dangerous or hostile to any part of the Christian system, it is a conclusion which enables us, in a dim way, not merely to hold as a belief, but to see as a necessary truth that there can be no chance in this world—and how it is, and must be, that to the All-seeing and All-knowing the future is as open as the present and the past. But none of these ideas involve the idea of compulsion, and the absence of compulsion is all that can be meant by freedom.—ARGYLL *Reign of Law*, ch. 6, p. 185. (Burt.)

2711. PREDICTION OF EARTHQUAKES—*True Prophecies Remembered, Erroneous Forgotten.*—Certain persons with whom I am intimate appear to have persuaded themselves that they can foretell the coming of an earthquake by the sultry state of the atmosphere or a certain oppressiveness they feel, and an instinctive feeling arises that an earthquake is at hand. . . . The author has had such sensations himelf, due, perhaps, to a knowledge that it was the earthquake season, that there had been no disturbance for some weeks, and a consequent increasing state of nervous presentiment. In consequence of this not only has he carefully prepared his instruments for the coming shock, but he has written and telegraphed to friends to do the same. Sometimes these guesses have proved correct. One remarkable instance was a few hours prior to the severe shock of February 22, 1880, when he wired to his friends in Yokohama and asked them to see that their instruments were in good order. Oftener, however, his prognostications have been incorrect. The point in connection with this subject which he wishes to be remarked is, that the instances where earthquakes occurred shortly after the receipt of his letters are carefully remembered, and often mentioned, but the instances in which earthquakes did not occur appear to be entirely forgotten. He is led to mention these facts because they appear to be an experimental proof of what has taken place in bygone times, and what still takes place, especially amongst savages—namely, that the record of that which is remarkable survives, whilst that which is of every-day occurrence quickly dies.—MILNE *Earthquakes*, ch. 18, p. 302. (A., 1899.)

2712. PREDICTION, SCIENTIFIC, FULFILLED—*Pasteur and Silkworms.*—It was not . . . easy to make the [silkworm] cultivators accept new guidance. To strike their imagination, and if possible determine their practise, Pasteur hit upon the expedient of prophecy. In 1866 he inspected, at St. Hippolyte-du-Fort, fourteen different parcels of eggs intended for incubation. Having examined a sufficient number of the moths which produced these eggs, he wrote out the prediction of what would occur in 1867, and placed the prophecy as a sealed letter in the hands of the Mayor of St. Hippolyte. In 1867 the cultivators communicated to the mayor their results. The letter of Pasteur was then opened and read, and it was found that in twelve out of fourteen cases there was absolute conformity between his prediction and the observed facts. Many of the groups had perished totally: the others had perished almost totally; and this was the prediction of Pasteur. In two out of the fourteen cases, instead of the prophesied destruction, half an average crop was obtained.—TYNDALL *Floating Matter of the Air*, essay 1, p. 13. (A., 1895.)

2713. ——— ——— *Scientist Foretells Result of Ignoring Scientific Laws—Lighting-mast on Capitol Destroyed by Electricity.*—[An] apparatus had been erected at great expense for the purpose of lighting the public grounds. It consisted of a mast reaching to the height of ninety feet above the apex of the dome of the Capitol [at Washington], terminated by a lantern about five feet in diameter and six or seven feet high. In this were jet gas-burners, equal in illuminating power, according to the statement of the projector of the arrangement, to six thousand wax candles.

After the whole apparatus had been prepared, the speaker was requested to give an opinion as to the effect which the lightning might have upon it. His answer was that it would attract the lightning from the

heavens, and tho the building might be protected by good conductors from the lantern to the earth, yet no protection which the present state of science could devise would be as safe as no exposure; the very idea of protection involving that of a less degree of danger. Tho in the case of the ordinary lightning-rod the lightning is seldom or never attracted from the cloud by the conductor, yet in this case the great height of the mast, the height of the dome above the ground, and the elevated position of the building itself gave a total elevation bearing a considerable ratio to the height of the cloud; add to this the great amount of metallic surface, and, above all, the large gas-burner, and we have an arrangement well calculated to elicit a discharge from the cloud when under ordinary influences no effect of the kind would take place. . . . The fixture on the Capitol was indeed an exploring apparatus on a magnificent scale. The result was such as had been anticipated. The first thunder-storm which passed over the city after the erection of the lantern discharged itself upon it, put out the light, and when the whole was taken down several perforations were found melted in the copper ball which surmounted the lantern. —HENRY *Remarks on the Form of Lightning-Rods (Scientific Writings*, vol. i, p. 291). (Sm. Inst., 1886.)

2714. PREOCCUPATION OF MIND PRODUCES INSENSIBILITY TO PAIN—The writer has himself frequently begun a lecture whilst suffering neuralgic pain so severe as to make him apprehend that he would find it impossible to proceed; yet no sooner has he by a determined effort fairly launched himself into the stream of thought than he has found himself continuously borne along without the least distraction until the end has come and the attention has been released, when the pain has recurred with a force that has overmastered all resistance, making him wonder how he could have ever ceased to feel it.—CARPENTER *Mental Physiology*, ch. 3, p. 138. (A., 1900.)

2715. PREPARATION, NATURE'S, FOR MOTHERHOOD—*Four Great Steps—The Young Fewer in Number, Recognizable at Birth, Needing Mother's Care, and Necessary to Mother's Comfort.*—Now, before maternal love can be evolved out of this first care, before love can be made a necessity, and carried past the unhatched egg to the living thing which is to come out of it, Nature must alter all her ways. Four great changes at least must be introduced into her program. In the first place she must cause fewer young to be produced at a birth. In the second place she must have these young produced in such outward form that their mothers will recognize them. In the third place, instead of producing them in such physical perfection that they are able to go out into life the moment they are born, she must make them helpless, so that for a time they must dwell with her if they are to live at all. And fourthly, it is required that she shall be made to dwell with them; that in some way they also should be made necessary—physically necessary—to her to compel her to attend to them. All these beautiful arrangements we find carried out to the last detail. A mother is made, as it were, in four processes. She requires, like the making of a colored picture, four separate paintings, each adding some new thing to the effect.—DRUMMOND *Ascent of Man*, ch. 8, p. 272. (J. P., 1900.)

2716. PRESENCE THAT FILLS IMMENSITY, THE—*Exalted Conception of the Divine Majesty.*—Shall we say, then, of these vast luminaries that they were created in vain? Were they called into existence for no other purpose than to throw a tide of useless splendor over the solitudes of immensity? Our sun is only one of these luminaries, and we know that he has worlds in his train. Why should we strip the rest of this princely attendance? Why may not each of them be the center of his own system, and give light to his own worlds? It is true that we see them not; but could the eye of man take its flight into those distant regions it would lose sight of our little world before it reached the outer limits of our system—the greater planets would disappear in their turn—before it had described a small portion of that abyss which separates us from the fixed stars, the sun would decline into a little spot, and all its splendid retinue of worlds be lost in the obscurity of distance; he would at last shrink into a small, indivisible atom, and all that could be seen of this magnificent system would be reduced to the glimmering of a little star. Why resist any longer the grand and interesting conclusion? Each of these stars may be the token of a system as vast and as splendid as the one which we inhabit. Worlds roll in these distant regions, and these worlds must be the mansions of life and of intelligence. In yon gilded canopy of heaven we see the broad aspect of the universe, where each shining point presents us with a sun, and each sun with a system of worlds; where the Divinity reigns in all the grandeur of his attributes; where he peoples immensity with his wonders, and travels in the greatness of his strength through the dominions of one vast and unlimited monarchy.—CHALMERS *Astronomical Discourses*, p. 31. (R. Ct., 1848.)

2717. PRESENT, THE ETERNAL—*A Spirit Projected Timelessly through Space Would See Ancient Deeds and Scenes as Present Fact—The Omnipresent also the Omniscient—"The High and Lofty One That Inhabiteth Eternity" (Is. lvii, 15).*—A man, a spirit, leaving the earth, either by death or otherwise, this year, and transported in some hours or days to a great distance, would see the earth of former times, and

would see himself again a child, for the aspect of the earth would not arrive where he was till after a long delay.

There is here neither a vision, nor a phenomenon of memory, nor a marvelous or supernatural action, but an actual, positive, natural, and incontestable fact; what has been for a long time the past for the earth is only the present for a distant observer in space. This vision is, none the less, very astonishing. Indeed, it is a singular fact that it is impossible to see the stars as they are at the moment when we examine them, and that we are only able to see their past!

Thus the progressive motion of light carries with it through infinitude the ancient history of all the suns and all the worlds expressed in an eternal present.

The metaphysical reality of this vast problem is such that we can now conceive the omnipresence of the world in all its duration. Events vanish for the place which brings them forth, but they remain in space. This successive and endless projection of all the facts accomplished on each of the worlds is performed in the bosom of the Infinite Being whose omnipresence thus maintains everything in an eternal permanence.—FLAMMARION *Popular Astronomy*, bk. vi, ch. 7, p. 617. (A.)

2718. PRESENT THE KEY TO PAST—*Rocks Worn Down Now as in Ancient Days.*—The present, geologists tell us, contains the key to the past. If we wish to find out how rocks have been removed, and what has since become of them, we must observe what is taking place under the influence of existing agents of change. How, then, are rocks being affected at present? We do not proceed far in our investigation before we discover that they are everywhere becoming disintegrated. In one place they are breaking up into angular fragments; in another, crumbling down into grit, sand, or clay. Brooks and rivers and the waves upon our coasts are constantly undermining them; everywhere, in short, rocks are being assaulted and reduced.—GEIKIE *Earth Sculpture*, ch. 2, p. 18. (G. P. P., 1898.)

2719. PRESERVATION OF STATUES IN BED OF LAVA—*Long-enduring Heat.*—But it must not be supposed that this complete fusion of rocky matter coming in contact with lava is of universal or even common occurrence. It probably happens when fresh portions of incandescent matter come successively in contact with fusible materials. In many of the dikes which intersect the tuffs and lavas of Etna there is scarcely any perceptible alteration effected by heat on the edges of the horizontal beds, in contact with the vertical and more crystalline mass. On the side of Mompiliere, one of the towns overflowed in [a previous] eruption . . . , an excavation was made in 1704, and by immense labor the workmen reached, at the depth of thirty-five feet, the gate of the principal church, where were three statues, held in high veneration. One of these, together with a bell, some money, and other articles, was extracted in a good state of preservation from beneath a great arch formed by the lava. It seems very extraordinary that any works of art, not encased with tuff, like those in Herculaneum, should have escaped fusion in hollow spaces left open in this lava-current, which was so hot at Catania eight years after it entered the town that it was impossible to hold the hand in some of the crevices.—LYELL *Principles of Geology*, bk. ii, ch. 25, p. 401. (A., 1854.)

2720. PRESSURE IN DEPTHS OF OCEAN—At a depth of 2,500 fathoms the pressure is, roughly speaking, two and a half tons per square inch—that is to say, several times greater than the pressure exerted by the steam upon the piston of our most powerful engines. Or, to put the matter in other words, the pressure per square inch upon the body of every animal that lives at the bottom of the Atlantic Ocean is about twenty-five times greater than the pressure that will drive a railway train.—HICKSON *Fauna of the Deep Sea*, ch. 2, p. 19. (A., 1894.)

2721. ——— *Drives Water into Pores of Sunken Wood.*—If wood be sunk to vast depths in the sea it may be impregnated with water suddenly. Captain Scoresby informs us, in his "Account of the Arctic Regions," that on one occasion a whale, on being harpooned, ran out all the lines in the boat, which it then dragged under water, to the depth of several thousand feet, the men having just time to escape to a piece of ice. When the fish returned to the surface "to blow" it was struck a second time, and soon afterwards killed. The moment it expired it began to sink—an unusual circumstance, which was found to be caused by the weight of the sunken boat, which still remained attached to it. By means of harpoons and ropes the fish was prevented from sinking until it was released from the weight by connecting a rope to the lines of the attached boat, which was no sooner done than the fish rose again to the surface. The sunken boat was then hauled up with great labor, for so heavy was it that, altho before the accident it would have been buoyant when full of water, yet it now required a boat at each end to keep it from sinking. "When it was hoisted into the ship the paint came off the wood in large sheets, and the planks, which were of wainscot, were as completely soaked in every pore as if they had lain at the bottom of the sea since the flood! A wooden apparatus that accompanied the boat in its progress through the deep, consisting chiefly of a piece of thick deal about fifteen inches square, happened to fall overboard, and tho it originally consisted of the lightest fir, sank in the water like a stone. The boat was rendered useless; even the wood of which it was

built, on being offered to the cook for fuel, was tried and rejected as incombustible."—LYELL *Principles of Geology*, bk. iii, ch. 47, p. 743. (A., 1854.)

2722. ——— ——— *Glass Crushed to Powder—Implosion vs. Explosion.*—A most beautiful experiment to illustrate the enormous force of this pressure was made during the voyage of H. M. S. "Challenger." I give the description of it in the words of the late Professor Moseley:

"Mr. Buchanan hermetically sealed up at both ends a thick glass tube full of air, several inches in length. He wrapped this sealed tube in flannel and placed it, so wrapped up, in a wide copper tube, which was one of those used to protect the deep-sea thermometers when sent down with the sounding apparatus.

"This copper tube was closed by a lid fitting loosely, and with holes in it, and the copper bottom of the tube similarly had holes bored through it. The water thus had free access to the interior of the tube when it was lowered into the sea, and the tube was necessarily constructed with that object in view, in order that in its ordinary use the water should freely reach the contained thermometer.

"The copper case containing the sealed glass tube was sent down to a depth of 2,000 fathoms and drawn up again. It was then found that the copper wall of the case was bulged and bent inwards opposite the place where the glass tube lay, just as if it had been crumpled inward by being violently squeezed.

"The glass tube itself, within its flannel wrapper, was found when withdrawn reduced to a fine powder, like snow almost. What had happened was that the sealed glass tube, when sinking to gradually increasing depths, had held out long against the pressure, but this at last had become too great for the glass to sustain, and the tube had suddenly given way and been crushed by the violence of the action to a fine powder. So violent and rapid had been the collapse that the water had not had time to rush in by means of the holes at both ends of the copper cylinder, and thus fill the empty space left behind by the collapse of the glass tube, but had instead crushed in the copper wall and brought equilibrium in that manner. The process is exactly the reverse of an explosion, and is termed by Sir Wyville Thomson an 'implosion.'"—HICKSON *Fauna of the Deep Sea*, ch. 2, p. 19. (A., 1894.)

2723. PRESSURE OF GLACIER—*Giant Power of Natural Agencies.*—The glacier does more than abrade. Rocks are not homogeneous; they are intersected by joints and places of weakness, which divide them into virtually detached masses. A glacier is undoubtedly competent to root such masses bodily away. Indeed, the mere a priori consideration of the subject proves the competence of a glacier to deepen its bed. Taking the case of a glacier 1,000 feet deep (and some of the older ones were probably three times this depth), and allowing 40 feet of ice to an atmosphere, we find that on every square inch of its bed such a glacier presses with a weight of 375 lbs., and on every square yard of its bed with a weight of 486,000 lbs. With a vertical pressure of this amount the glacier is urged down its valley by the pressure from behind. We can hardly, I think, deny to such a tool a power of excavation.—TYNDALL *Hours of Exercise in the Alps*, ch. 20, p. 239. (A., 1898.)

2724. ——— ——— *Its Grinding Power.*—The movement of glacial ice causes friction and leads to the grinding, smoothing, and scratching of the rocks over which it passes. The intensity of this grinding can be appreciated to some extent by considering the force with which a thick ice mass presses on the rocks beneath. The weight of a cubic foot of ice is about fifty-seven pounds, hence a glacier 1,000 feet thick, which is by no means the maximum, would exert a pressure on its bed of twenty-eight tons to the square foot. A movement of ice charged with sand and stones under such a pressure cannot fail to produce abrasion of the rocks beneath.—RUSSELL *Glaciers of North America*, int., p. 18. (G. & Co., 1897.)

2725. PREVISION IN BIRDS AND INSECTS—*Mystery of Lower Organisms.*—Those birds and insects whose young are hatched by the heat of fermentation have an intuitive impulse to select the proper materials, and to gather them for the purpose. All creatures, guided sometimes apparently by senses of which we know nothing, are under like impulses to provide effectually for the nourishing of their young. It is, moreover, most curious and instructive to observe that the extent of prevision which is involved in this process and in the securing of the result seems very often to be greater as we descend in the scale of Nature, and in proportion as the parents are dissociated from the actual feeding or personal care of their young. The mammalia have nothing to provide except food for themselves, and have at first, and for a long time, no duty to perform beyond the discharge of a purely physical function. Milk is secreted in them by a purely unconscious process, and the young need no instruction in the art of sucking. Birds have much more to do—in the building of nests, in the choice of sites for these, and, after incubation, in the choice of food adapted to the period of growth. Insects, much lower in the scale of organization, have to provide very often for a much more distant future, and for various stages of development.—ARGYLL *Unity of Nature*, ch. 2, p. 40. (Burt.)

2726. PREVISION IN INSECTS—*Ants Caring for Eggs of Aphides.*—Here are aphides, not living in the ants' nests, but out-

side, on the leaf-stalks of plants. The eggs are laid early in October on the food-plant of the insect. They are of no direct use to the ants, yet they are not left where they are laid, exposed to the severity of the weather and to innumerable dangers, but brought into their nests by the ants, and tended by them with the utmost care through the long winter months until the following March, when the young ones are brought out and again placed on the young shoots of the daisy. This seems to me a most remarkable case of prudence. Our ants may not, perhaps, lay up food for the winter, but they do more, for they keep during six months the eggs which will enable them to procure food during the following summer, a case of prudence unexampled in the animal kingdom.—AVEBURY *Ants, Bees, and Wasps,* ch. 4, p. 73. (A., 1900.)

2727. ——— ——— *The Carpenter-bee —Remarkable Congenital Instinct of Larvæ.*—The carpenter-bee was first observed and described by Réaumur. It makes a long cylindrical tube in the wood of beams, palings, etc. This it divides into a number of successive chambers by partitions made of agglutinated sawdust built across the tube at right angles to its axis. In each chamber there is deposited a single egg, together with a store of pollen for the nourishment of the future larva. The larvæ hatch out in succession and in the order of their age—*i. e.*, the dates at which they were deposited. To provide for this, the bee bores a hole from the lower cell to the exterior, so that each larva, when ready to escape from its chamber, finds an open way from the tube. The larvæ have to cut their own way out through the walls of their respective chambers, and it is remarkable that they always cut through the wall that faces the tubular passage left by the parent; they never bore their way out in the opposite direction, which, were they to do so, would entail the destruction of all the other and immature larvæ.—ROMANES *Animal Intelligence,* ch. 4, p. 179. (A., 1899.)

2728. PREVISION OF THOUGHT—*Emphasis in Reading Shows Sense of Words to Come.*—How comes it about that a man reading something aloud for the first time is able immediately to emphasize all his words aright, unless from the very first he have a sense of at least the form of the sentence yet to come, which sense is fused with his consciousness of the present word, and modifies its emphasis in his mind so as to make him give it the proper accent as he utters it? Emphasis of this kind is almost altogether a matter of grammatical construction. If we read "no more" we expect presently to come upon a "than"; if we read "however" at the outset of a sentence it is a "yet," a "still," or a "nevertheless" that we expect. A noun in a certain position demands a verb in a certain mood and number, in another position it expects a relative pronoun. Adjectives call for nouns, verbs for adverbs, etc., etc. And this foreboding of the coming grammatical scheme combined with each successive uttered word is so practically accurate that a reader incapable of understanding four ideas of the book he is reading aloud can nevertheless read it with the most delicately modulated expression of intelligence.—JAMES *Psychology,* vol. i, ch. 9, p. 253. (H. H. & Co., 1899.)

2729. PRIDE OF HALF-KNOWLEDGE —*Scientific Basis for Practical Precaution— Thin Coverings Protect from Frost.*—We have the following beautiful passage in the "Essay" of Wells: "I had often, in the pride of half-knowledge, smiled at the means frequently employed by gardeners to protect tender plants from cold, as it appeared to me impossible that a thin mat or any such flimsy substance could prevent them from attaining the temperature of the atmosphere, by which alone I thought them liable to be injured. But when I had learned that bodies on the surface of the earth become, during a still and serene night, colder than the atmosphere, by radiating their heat to the heavens, I perceived immediately a just reason for the practise which I had before deemed useless."—TYNDALL *Heat a Mode of Motion,* lect. 17, p. 500. (A., 1900.)

2730. PRINCIPLE OF LIFE ONE THROUGH ALL NATURE AND ALL TIME —Whatever else may be true, the conviction is brought home to us that in all this endless multifariousness there is one single principle at work, that all is tending toward an end that was involved from the very beginning, if one can speak of beginnings and ends where the process is eternal. The whole universe is animated by a single principle of life; and whatever we see in it, whether to our half-trained understanding and narrow experience it may seem to be good or bad, is an indispensable part of the stupendous scheme.—FISKE *Through Nature to God,* pt. i, ch. 4, p. 24. (H. M. & Co., 1900.)

2731. PRINCIPLES, NEW, OF LOCOMOTION—*Changes in Habits and Speech.*— During the nineteenth century three distinct modes of locomotion have been originated and brought to a high degree of perfection. Two of them, the locomotive and the steamship, are altogether different in principle from what had gone before. Up to the very times of men now living, all our locomotion was on the same old lines which had been used for thousands of years. It had been improved in details, but without any alteration of principle and without any very great increase of efficiency. The principles on which our present methods rest are new; they already far surpass anything that could be effected by the older methods; with wonderful rapidity they have spread

over the whole world, and they have in many ways modified the habits and even the modes of speech of all civilized peoples.—WALLACE *The Wonderful Century*, ch. 1, p. 10. (D. M. & Co., 1899.)

2732. PRINTING INVENTED IN CHINA—*Block-books.*—This [printing] was a process simple enough in itself, and indeed well known from remote ages. Every Egyptian or Babylonian who smeared some black on his signet-ring or engraved cylinder, and took off a copy, had made the first step towards printing. But easy as the further application now seems to us, no one in the Old World saw it. It appears to have been the Chinese who invented the plan of engraving a whole page of characters on a wood-block and printing off many copies. They may have begun as early as the sixth century, and at any rate in the tenth century they were busy printing books. The Chinese writing, from its enormous diversity of characters, is not well suited to printing by movable types, but there is a record that this plan was early devised among them, having been carried on with separate terra-cotta types in the eleventh century. Moslem writers early in the fourteenth century describe Chinese printing, so that it was probably through them that the art found its way to Europe, where not long afterwards the so-called "block-books," printed from whole-page wood-blocks after the Chinese manner, make their appearance, followed by books printed with movable types. Few questions have been more debated by antiquaries than the claims of Gutenberg, Faust, and the others to their share of honor as the inventors of printing. Great as was the service these worthies did to the world, it is only fair to remember that what they did was but to improve the practical application of a Chinese invention. Since their time progress has been made in cheapening types, making paper by machinery, improving the presses, and working them by steam-power, but the idea remains the same.—TYLOR *Anthropology*, ch. 7, p. 180. (A., 1899.)

2733. PRIORITY OF DISCOVERY, SPURIOUS CLAIMS OF—*Everything Said by Some One Somewhere—Chance Utterance Is Not Discovery.*—In the hundreds of books and pamphlets which are every year published about ether, the structure of atoms, the theory of perception, as well as on the nature of the asthenic fever and carcinoma, all the most refined shades of possible hypotheses are exhausted, and among these there must necessarily be many fragments of the correct theory. But who knows how to find them? I insist upon this in order to make clear to you that all this literature, of untried and unconfirmed hypotheses, has no value in the progress of science. One who wants to publish something really new—facts—sees himself open to the danger of countless claims of priority, unless he is prepared to waste time and power in reading beforehand a quantity of absolutely useless books, and to destroy his readers' patience by a multitude of useless quotations.—HELMHOLTZ *Popular Lectures*, lect. 5, p. 229. (L. G. & Co., 1898.)

2734. ——— ——— *Truth May Appear by Accident amid Any Flood of Error—Discovery Gives Reason and Proof of Truth.*—To find superficial resemblances is easy; it is amusing in society, and witty thoughts soon procure for their author the name of a clever man. Among the great number of such ideas there must be some which are ultimately found to be partially or wholly correct; it would be a stroke of skill always to guess falsely. In such a happy chance a man can loudly claim his priority for the discovery; if otherwise, a lucky oblivion conceals the false conclusions. The adherents of such a process are glad to certify the value of a first thought. Conscientious workers who are shy at bringing their thoughts before the public before they have tested them in all directions, solved all doubts, and have firmly established the proof, these are at a decided disadvantage.—HELMHOLTZ *Popular Lectures*, lect. 5, p. 228. (L. G. & Co., 1898.)

2735. PROBLEM OF LAW AND LIBERTY—*How Much Control by Government?—How Much Freedom, Even if Abused?*—As the motives which determine individual conduct are not always reasonable motives, so it is clear that what men naturally do is no sure test either of what they ought to do or of what they ought to be allowed to do. It is their nature, under certain conditions, to do all that is bad and injurious to themselves and others. Hence it is the most difficult of all problems in the science of government to determine when, where, and how it is wise to interfere by the authority of law with the motives which are usually called the natural motives of men. The question is no other than this: How far the abuse of those motives can be checked and resisted by that public authority whose duty and function it is to place itself above the influences which, in individual men, overpower the voice of reason and of conscience.—ARGYLL *Reign of Law*, ch. 7, p. 199. (Burt.)

2736. PROBLEM OF MORAL EVIL—*Why Is Righteousness Not Automatic?*—The question then arises, as one of the greatest of all mysteries, how it is and why it is that the higher gifts of man's nature should not have been associated with corresponding dispositions to lead as straight and as unerringly to the crown and consummation of his course as the dispositions of other creatures do lead them to the perfect development of their powers and the perfect discharge of their functions in the economy of Nature?—ARGYLL *Unity of Nature*, ch. 9, p. 219. (Burt.)

2737. PROBLEM OF SCIENCE, A— *Flowers and Trees Absorb Different Colors —Is the Plant Affected by the Difference?*— Both in foliage and in flowers we have striking differences of absorption. The copper beech and the green beech, for example, take in different rays. But the very growth of the tree is due to some of the rays thus taken in. Are the chemical rays, then, the same in the copper and the green beech? In two such flowers as the primrose and the violet, where the absorptions, to judge by the colors, are almost complementary, are the chemically active rays the same? The general relation of color to chemical action is worthy of the application of the method by which Dr. Draper proved so conclusively the chemical potency of the yellow rays.—TYNDALL *Lectures on Light,* lect. 1, p. 39. (A., 1898.)

2738. PROBLEM OR HYPOTHESIS NOT TO BE MADE DOCTRINE—" We must draw [it is said] a strict distinction between what we wish to teach and what we wish to search for. The objects of our research are expressed as problems (or hypotheses). We need not keep them to ourselves; we are ready to communicate them to all the world, and say, 'There is the problem; that is what we strive for.' . . . The investigation of such problems, in which the whole nation may be interested, cannot be restricted to any one. This is freedom of inquiry. But the problem (or hypothesis) is not, without further debate, to be made a doctrine."—TYNDALL *Fragments of Science,* vol. ii, ch. 15, p. 397. (A., 1900.)

2739. PROBLEMS OF THE DEEP— When it was found that animals can and do live even at the greatest depths of the ocean, the interest of naturalists was concentrated on the solution of the following problems. Firstly, do the animals constituting the fauna of the abyss exhibit any striking and constant modification in correlation with the physical conditions of their strange habitat? And, secondly, from what source was the fauna of the abyss derived? Was it derived from the shallow shore waters, or from the surface of the sea? Is it of very ancient origin, or the result of, comparatively speaking, recent immigrations?—HICKSON *Fauna of the Deep Sea,* pref., p. 10. (A., 1898.)

2740. PROBLEMS YET UNSOLVED— *Decision of Science Waits for Facts—Tentative Hypotheses.*—It must be admitted, then, that the questions of the nature of the earth's interior and the cause of the high temperatures which produce volcanic phenomena are still open ones. We have not yet got beyond the stage of endeavoring to account for the facts observed by means of tentative hypotheses. Some of these, as we have seen, agree with the facts, so far as they are at present known, much better than others; but the decision between them, or the rejection of the whole of them in favor of some new hypothesis, must depend on the results of future observation and inquiry.—JUDD *Volcanoes,* ch. 12, p. 352. (A., 1899.)

2741. ——— ——— *Vain Search for Intra-Mercurian Planet—Perturbations of Mercury Still Unexplained.*—Intra-Mercurian planets have . . . been diligently searched for when the opportunity of a total eclipse offered, especially during the long obscuration at Caroline Island. Not only did Professor Holden "sweep" in the solar vicinity, but Palisa and Trouvelot agreed to divide the field of exploration, and thus make sure of whatever planetary prey there might be within reach; yet with only negative results. Belief in the presence of any considerable body or bodies within the orbit of Mercury is, accordingly, now at a low ebb. Yet the existence of the anomaly in the Mercurian movements indicated by Le Verrier has been made only surer by further research. Its elucidation constitutes one of the "pending problems" of astronomy.—CLERKE *History of Astronomy,* pt. ii, ch. 7, p. 308. (Bl., 1893.)

2742. PROCESS OF CRYSTALLIZATION SEEN BY MEANS OF SOLAR MICROSCOPE — Cleansing perfectly a glass plate, the solution of the chlorid [common sal ammoniac, or ammonium, dissolved in water] is poured over the glass, to which, when the plate is set on edge, a thin film of the liquid adheres. Warming the glass slightly, evaporation is promoted, but by evaporation the water only is removed. The plate is then placed in a solar microscope, and an image of the film is thrown upon a white screen. The warmth of the illuminating beam adds itself to that already imparted to the glass plate, so that after a moment or two the dissolved salt can no longer exist in the liquid condition. Molecule then closes with molecule, and you have a most impressive display of crystallizing energy overspreading the whole screen. You may produce something similar if you breathe upon the frost-ferns which overspread your window-panes in winter, and then observe through a pocket-lens the subsequent recongelation of the film. In this case the crystallizing force is hampered by the adhesion of the film to the glass; nevertheless, the play of power is strikingly beautiful.—TYNDALL *Lectures on Light,* lect. 3, p. 103. (A., 1898.)

2743. PROCESS SUCCESSFULLY USED, WHILE REASON UNKNOWN— *Real Cause of Fermentation Discovered by Pasteur.*—It was Pasteur who in 1857 first propounded the true cause and process of fermentation. The breaking-down of sugar into alcohol and carbonic acid gas had been known, of course, for a long period. Since the time of Spallanzani (1776) the putrefactive changes in liquids and organic matter had been prevented by boiling and subsequently sealing the flask or vessel con-

taining the fluid. Moreover, this successful preventive practise had been in some measure correctly interpreted as due to the exclusion of the atmosphere, but wrongly credited to the exclusion of the oxygen of the air. It was not until the beginning of the present century that authorities modified their view and declared in favor of yeast-cells as the agents in the production of fermentation.—NEWMAN *Bacteria*, ch. 4, p. 111. (G. P. P., 1899.)

2744. PRODUCT OF EVOLUTION MORE IMPORTANT THAN THE PROCESS —*Love the Final and Supreme Result.*—But, after all, the miracle of evolution is not the process, but the product. Beside the wonder of the result, the problem of the process is a mere curiosity of science. For what is the product? It is not mountain and valley, sky and sea, flower and star, this glorious and beautiful world in which man's body finds its home. It is not the godlike gift of mind nor the ordered cosmos where it finds so noble an exercise for its illimitable powers. It is that which of all other things in the universe commends itself, with increasing sureness as time goes on, to the reason and to the heart of humanity—love. Love is the final result of evolution. This is what stands out in Nature as the supreme creation.—DRUMMOND *Ascent of Man*, ch. 10, p. 335. (J. P., 1900.)

2745. PRODUCT OF SLIGHT FORCE BY VAST PERIOD—*Power of "Patient Continuance" (Rom. ii, 7)—The Silent Activities.*—There is no fact which the geological student is more constantly called upon to bear in mind than that of the potency of seemingly insignificant causes which continue in constant operation through long periods of time. Indeed, these small and almost unnoticed agencies at work upon the earth's crust are often found, in the long run, to produce far grander effects than those of which the action is much more striking and obvious. It is to the silent and imperceptible action of atmospheric moisture and frost that the disintegration of the solid rock-masses must be mainly ascribed; and the noisy cataract and ocean billow produce effects which are quite insignificant compared with those which must be ascribed to the slight and almost unnoticed forces. Great masses of limestone are built up of the remains of microscopic organisms, while the larger and higher life forms contribute but little to the great work of rock-building.—JUDD *Volcanoes*, ch. 10, p. 302. (A., 1899.)

2746. PROFICIENCY INCREASED BY REST—We notice after exercising our muscles or our brain in a new way that we can do so no longer at that time; but after a day or two of rest, when we resume the discipline, our increase in skill not seldom surprises us. I have often noticed this in learning a tune; and it has led a German author to say that we learn to swim during the winter and to skate during the summer.—JAMES *Psychology*, vol. i, ch. 4, p. 110. (H. H. & Co., 1899.)

2747. PROGENY OF LOWER ANIMALS MULTITUDINOUS—*Love Then Impossible—No Ethical Result Attained.*—The humbler denizens of the world produce offspring, not by units or tens, but by thousands and millions; and with populations so vast, maternal protection is not required to sustain the existence of the species. It was probably on the whole a better arrangement to produce a million and let them take their chance, than to produce one and take special trouble with it. It was easier, moreover, a thousand times easier, for Nature to make a million young than one mother. But the ethical effect, if one may use such a term here, of this early arrangement was nil. All this saving of motherly trouble meant for a long space in Nature complete absence of maternal training. With children of this sort motherhood had no chance. There was no time to love, no opportunity to love, and no object to love. It was a period of physical installations; and of psychical installations only as establishing the first stages of the maternal instinct—the prenatal care of the egg. This is a necessary beginning, but it is imperfect; it arrests itself at the critical point, where care can react upon the mother.—DRUMMOND *Ascent of Man*, ch. 8, p. 271. (J. P., 1900.)

2748. PROGRESS BY DISREGARD OF PLEASURE AND PAIN—Pleasure and pain are undoubtedly powerful as spur and bridle and bit in the struggle for existence. But whatever biology and certain doctrines of political economy may see fit to hold on this subject, psychology cannot find that the facts testify to this side of life as being by life any means all-powerful. Indeed, *all human life develops largely by relegating the immediate effects of our activity, as respects the quantities of pleasure or pain evoked, more and more into the background.*—LADD *Psychology*, ch. 10, p. 197. (S., 1899.)

2749. PROGRESS BY INTERCOURSE AND INTERCHANGE—*A Prophet without Honor in His Own Country.*—Humanity would probably not have progressed very far from its original state if the separate tribes and peoples had not mutually exchanged their small steps of progress, and constantly enriched their scanty possessions in culture by borrowing from others. Just the rigidness of the people's soul that timidly refuses every venture, everything untried, justifies the assumption that every nation has derived a great percentage of its endowments and opinions at second hand; [and this is further evident from the fact that] naturally the example of an entire neighboring tribe exercises a stronger and more convincing effect than the most living demonstration from a member of one's own society, whose

ideas in the eyes of his comrades "haven't traveled from a distance." The ancient saying, "A prophet is not without honor save in his own country," illumines the situation. This borrowing would be still more frequent if the petty tribal animosities, which among peoples of higher culture take the form of national pride, did not hinder a more energetic leaning toward foreign standards.—SCHURTZ *Urgeschichte der Kultur*, p. 58. (Translated for *Scientific Side-Lights.)*

2750. PROGRESS CHARACTERIZES TRUE SCIENCE—The beauty of all truly scientific work is to get to ever deeper levels.—JAMES *Psychology*, vol. ii, ch. 25, p. 448. (H. H. & Co., 1899.)

2751. PROGRESS FROM IMPLEMENT TO MACHINE—*From Hand-power to Use of Elemental Forces.*—The ingenuity of man has been eminent in the art of destroying his fellow men. In surveying the last group of deadly weapons, from the stone hurled by hand to the rifled cannon, there comes well into view one of the great advances of culture. This is the progress from the simple tool or implement, such as the club or knife, which enables man to strike or cut more effectively than with hands or teeth, to the machine which, when supplied with force, only needs to be set and directed by man to do his work. Man often himself provides the power which the machine distributes more conveniently, as when the potter turns the wheel with his own foot, using his hands to mold the whirling clay. The highest class of machines are those which are driven by the stored-up forces of Nature, like the sawmill, where the running stream does the hard labor, and the sawyer has only to provide the timber and direct the cutting.—TYLOR *Anthropology*, ch. 8, p. 197. (A., 1899.)

2752. PROGRESS, MENTAL, SUPERSEDES PHYSICAL—*Mind Gives Man Dominion.*—No fact in Nature is fraught with deeper meaning than this two-sided fact of the extreme physical similarity and enormous psychical divergence between man and the group of animals to which he traces his pedigree. It shows that when humanity began to be evolved an entirely new chapter in the history of the universe was opened. Henceforth the life of the nascent soul came to be first in importance, and the bodily life became subordinated to it. Henceforth it appeared that, in this direction at least, the process of zoological change had come to an end, and a process of psychological change was to take its place. Henceforth along this supreme line of generation there was to be no further evolution of new species through physical variation, but through the accumulation of psychical variations one particular species was to be indefinitely perfected and raised to a totally different plane from that on which all life had hitherto existed. Henceforth, in short, the dominant aspect of evolution was to be not the genesis of species, but the progress of civilization.—FISKE *Destiny of Man*, ch. 3, p. 29. (H. M. & Co., 1900.)

2753. PROGRESS OF HUMANITY—*Guides for the Study of Types of Ancient Culture Now Existent.*—There are five guides [from helplessness to power] whose services we have to engage on our interesting journey. The first is History, who does not know the way very far back—not over three thousand years—with much certainty. The second is Philosophy, the study of which in our own century has enabled us to find the cradle-land of many peoples. The third is Folk-lore, the survival of belief and custom among the uneducated. The fourth is Archeology, history written in things. The fifth is Ethnology, which informs us that in describing this arc of civilization some races have only marked time, while others have moved with radii of varying lengths. The result of this is that we now have on the earth types of every sort of culture it has ever known.—MASON *The Birth of Invention (Address at Centenary of American Patent System, Washington, D. C., 1891; Proceedings of the Congress*, p. 406).

2754. ——— ——— *Improvement by Individual Effort—Civilization a Condition of Unstable Equilibrium—Hopeful Result of Education.*—There have been various centers and periods of civilization. Egypt, Greece, and Rome, tho they have left an impress upon the world which extends even to our time, and modifies all the present, have themselves "moldered down." It appears, therefore, that civilization itself may be considered as a condition of unstable equilibrium, which requires constant effort to be sustained, and a still greater effort to be advanced. It is not, in my view, the manifest destiny of humanity to improve by the operation of an inevitable necessary law of progress; but while I believe that it is the design of Providence that man should be improved, this improvement must be the result of individual effort, or of the combined effort of many individuals, animated by the same feeling, and cooperating for the attainment of the same end. The world is still in a degraded condition; ignorance, want, rapine, murder, superstition, fraud, uncleanliness, inhumanity, and malignity abound. We thank God, however, that he has given us the promise, and in some cases the foretaste, of a happier and holier condition; that he has vouchsafed to us as individuals, each in his own sphere, the privilege, and has enjoined upon us the duty, of becoming his instruments, and thus coworkers in ameliorating the condition of ourselves and our fellow men; and above all, that he has enabled us through education to improve the generations which are to follow us. If we sow judiciously in the present the world will assuredly reap a beneficent har-

vest in the future; and he has not lived in vain who leaves behind him as his successor a child better educated morally, intellectually, and physically than himself.—HENRY *Thoughts on Education (Scientific Writings*, vol. i, p. 327). (Sm. Inst., 1886.)

2755. PROGRESS OF LIFE IN GEOLOGIC TIME—*Prolific Periods and Epochs.*—Just as the growth of trees is promoted or arrested by the vicissitudes of summer and winter, so in the course of the geological history there have been periods of pause and acceleration in the work of advancement. This is in accordance with the general analogy of the operations of Nature, and is in no way at variance with the doctrine of uniformity already referred to. Nor has it anything in common with the unfounded idea, at one time entertained, of successive periods of entire destruction and restoration of life. Prolific periods of this kind appear in the marine invertebrates of the early Cambrian, the plants and fishes of the Devonian, the batrachians of the Carboniferous, the reptiles of the Trias, the broad-leaved trees of the Cretaceous, and the mammals of the early Tertiary. A remarkable contrast is afforded by the later Tertiary and modern time, in which, with the exception of man himself, and perhaps a very few other species, no new forms of life have been introduced, while many old forms have perished.—DAWSON *Facts and Fancies in Modern Science*, lect. 3, p. 124. (A. B. P. S.)

2756. PROGRESS OF SCIENCE—*Advance by Rejection of Ancient Dogmas—Language Still Preserves Old Forms.*—The dogmas of former ages survive now only in the superstitions of the people and the prejudices of the ignorant, or are perpetuated in a few systems, which, conscious of their weakness, shroud themselves in a veil of mystery. We may also trace the same primitive intuitions in languages exuberant in figurative expressions; and a few of the best chosen symbols engendered by the happy inspiration of the earliest ages, having by degrees lost their vagueness through a better mode of interpretation, are still preserved among our scientific terms.—HUMBOLDT *Cosmos*, vol. i, int., p. 24. (H., 1897.)

2757. ——— ——— *A Rhythmic Movement—Retardation the Prelude to Swifter Advance.*—Newton's espousal of the emission theory [of light] is said to have retarded scientific discovery. It might, however, be questioned whether, in the long run, the errors of great men have not really their effect in rendering intellectual progress rhythmical, instead of permitting it to remain uniform, the "retardation" in each case being the prelude to a more impetuous advance. It is confusion and stagnation, rather than error, that we ought to avoid. Thus, tho the undulatory theory was held back for a time, it gathered strength in the interval, and its development within the last half century has been so rapid and triumphant as to leave no rival in the field.—TYNDALL *Lectures on Light*, lect. 2, p. 80. (A., 1898.)

2758. ——— ——— *New Methods of Research.*—Comparing the methods now available for astronomical inquiries with those in use thirty years ago, we are at once struck with the fact that they have multiplied. The telescope has been supplemented by the spectroscope and the photographic camera. Now this really involves a whole world of change. It means that astronomy has left the place where she dwelt apart in rapt union with mathematics, indifferent to all things on earth save only to those mechanical improvements which should aid her to penetrate further into the heavens, and has descended into the forum of human knowledge, at once a suppliant and a patron, alternately invoking help from and promising it to each of the sciences, and patiently waiting upon the advance of all. The science of the heavenly bodies has, in a word, become a branch of terrestrial physics, or rather a higher kind of integration of all their results.—CLERKE *History of Astronomy*, pt. ii, ch. 13, p. 512. (Bl., 1893.)

2759. PROGRESS, SOCIAL—*Intellectual Beliefs Direct—Feelings Impel to Action—Steam and Steersman.*—It was not human emotions and passions which discovered the motion of the earth, or detected the evidence of its antiquity; which exploded scholasticism, and inaugurated the exploration of Nature; which invented printing, paper, and the mariner's compass. Yet the Reformation, the English and French Revolutions, and still greater moral and social changes yet to come, are direct consequences of these and similar discoveries. Even alchemy and astrology were not believed because people thirsted for gold and were anxious to pry into the future, for these desires are as strong now as they were then; but because alchemy and astrology were conceptions natural to a particular stage in the growth of human knowledge, and consequently determined during that stage the particular means whereby the passions which always exist sought their gratification. To say that men's intellectual beliefs do not determine their conduct is like saying that the ship is moved by the steam and not by the steersman. The steam, indeed, is the motive power; the steersman, left to himself, could not advance the vessel a single inch, yet it is the steersman's will and the steersman's knowledge which decide in what direction it shall move and whither it shall go.—MILL *Positive Philosophy of Auguste Comte*, p. 96. (H. H. & Co., 1887.)

2760. PROGRESS, UNCONSCIOUS—*The Greatest Movements Least Perceptible to Those Borne Onward by Them.*—If we ride in a well-appointed carriage with good

springs, upon a railway which is in excellent order, the movement is almost imperceptible to us, and the rate of speed may be increased indefinitely without making itself apparent to our senses. The smallest impediment to the evenness of the movement—such as that produced by a small object placed upon the rails—at once makes itself felt by a violent jar and vibration. How perfectly insensible we may be of the grandest and most rapid movements is taught us by the facts demonstrated by the astronomer. By the earth's daily rotation we are borne along at a rate which in some places amounts to over 1,000 miles an hour, and by its annual revolution we are every hour transported through a distance of 70,000 miles; yet concerning the fact and direction of these movements we are wholly unconscious.—JUDD *Volcanoes*, ch. 10, p. 285. (A., 1899.)

2761. PROOF, FIRST, OF DEEP-SEA FAUNA—*Commercial Industry Aids Science.*—The first direct proof of the existence of an invertebrate fauna in deep seas was found by the expedition that was sent to repair the submarine cable of the Mediterranean Telegraph Company. The cable had broken in deep water, and a ship was sent out to examine and repair the damage. When the broken cable was brought on deck it bore several forms of animal life that must have become attached to it and lived at the bottom of the sea in water extending down to a depth of 1,200 fathoms. Among other forms a caryophyllia was found attached to the cable at 1,100 fathoms, an oyster *(Ostrea cochlear)*, two species of pecten, two gasteropods, and several worms.—HICKSON *Fauna of the Deep Sea*, ch. 1, p. 7. (A., 1894.)

2762. PROOFS FROM THE VAST AND THE MINUTE UNITE—*Gases Imprisoned in the Fluid Rock of Volcanoes.*—That the molten materials which issue from volcanic vents have absorbed enormous quantities of steam and other gases we have the most undisputable evidence. The volume of such gases given off during volcanic outbursts, and while the lava-streams are flowing and consolidating, is enormous, and can only be accounted for by supposing that the masses of fluid rock have absorbed many times their volume of the gases. But we have another not less convincing proof of the same fact in the circumstance that volcanic materials which have consolidated under great pressure—such as granites, gabbros, porphyries, etc.—exhibit in their crystals innumerable cavities containing similar gases in a liquefied state.

It is to the violent escape of these gases from the molten rock-masses, as the pressure upon them is relieved, that nearly all the active phenomena of volcanoes must be referred.—JUDD *Volcanoes*, ch. 12, p. 357. (A., 1899.)

2763. PROPAGATION, RECTILINEAR, OF LIGHT—*Crossing of Rays with Inversion of Image—Overlapping Images.*—The following instructive experiment depends on the rectilinear propagation of light. Make a small hole in a closed window-shutter, before which stands a house or a tree, and place within the darkened room a white screen at some distance from the orifice. Every straight ray proceeding from the house or tree stamps its color upon the screen, and the sum of all the rays will, therefore, be an image of the object. But, as the rays cross each other at the orifice, the image is inverted. At present we may illustrate and expand the subject thus: In front of our camera is a large opening . . . from which the lens has been removed, and which is closed at present by a sheet of tin-foil. Pricking by means of a common sewing-needle a small aperture in the tin-foil, an inverted image of the carbon-points starts forth upon the screen. A dozen apertures will give a dozen images, a hundred a hundred, a thousand a thousand. But, as the apertures come closer to each other, that is to say, as the tin-foil between the apertures vanishes, the images overlap more and more. Removing the tin-foil altogether, the screen becomes uniformly illuminated. Hence the light upon the screen may be regarded as the overlapping of innumerable images of the carbon-points. In like manner the light upon every white wall on a cloudless day may be regarded as produced by the superposition of innumerable images of the sun.—TYNDALL *Lectures on Light*, lect. 1, p. 9. (A., 1898.)

2764. PROPERTIES OF MATTER TREATED AS CAUSES—The physicist who deduces from the activities of different forms of matter certain "properties" which he attributes to them, and then uses these very "properties" to account for those activities, is obviously reasoning in a circle.—CARPENTER *Nature and Man*, lect. 15, p. 411. (A., 1889.)

2765. PROPHECY IN SCIENCE—*Spectral Lines—Foreseeing Discovery of New Planet—God Communicating with Rational Creatures.*—If the possibility of God communicating with his rational creatures be conceded, then the objections taken to prophecy lose all value. If anything known to God and unknown to man can be revealed, things past and future may be revealed as well as things present. Science abounds in prophecy. All through the geological history there have been prophetic types, mute witnesses to coming facts. Minute disturbances of heavenly bodies, altogether inappreciable by the ordinary observer, enable the astronomer to predict the discovery of new planets. A line in a spectrum, without significance to the uninitiated, foretells a new element. The merest fragment, sufficient only for microscopic examination, enables the paleontologist to describe to incredulous auditors some organism altogether unknown in its entire structures. What

possible reason can there be for excluding such indications of the past and the future from a revelation made by him who knows perfectly the end from the beginning, and to whom the future results of human actions to the end of time must be as evident as the simplest train of causes and effects is to us? [See PREDICTION.]—DAWSON *Facts and Fancies in Modern Science*, lect. 6, p. 231. (A. B. P. S.)

2766. PROPORTION BETWEEN EXTENT OF AURORA AND ITS HEIGHT— It must be noted that the extent of the aurora appears to bear a certain relation to its height. The extensive auroras—those, for instance, which are seen simultaneously in the two hemispheres—appear to shine from an immense height. On the other hand, the auroras which are at low levels are always very limited in area, or even purely local. This appears to be another point in favor of the opinion already stated, namely, that these two categories of auroras are really distinct phenomena, both in their properties and in their origin.—ANGOT *Aurora Borealis*, ch. 4, p. 56. (A., 1897.)

2767. PROSPERITY MADE POSSIBLE BY SOCIAL ORDER— *Utility of Ancient Creeds and Cults.*—Even the creeds and cults of mankind, whatever view you may take of the divine element underneath them, have been thought out and wrought out with infinite pains from time to time by earnest souls. But they had their origin in the cradle-land and in the infancy of our race. What we enjoy is only the full-blown flower, the perfected fruit of which they possessed the germ. Let me enforce this idea, as we glorify the material prosperity of the nineteenth century, that many centuries ago men sat down and with great pains and sorrow invented the language, the art, the industries, the social order which made our machines feasible and desirable.—MASON *The Birth of Invention (Address at Centenary of American Patent System, Washington, D. C., 1891; Proceedings of the Congress*, p. 407).

2768. PROSPERITY OF NATIONS THE RESULT OF SCIENTIFIC PROGRESS—An equal appreciation of all branches of the mathematical, physical, and natural sciences is a special requirement of the present age, in which the material wealth and the growing prosperity of nations are principally based upon a more enlightened employment of the products and forces of Nature. The most superficial glance at the present condition of Europe shows that a diminution or even a total annihilation of national prosperity must be the award of those states who shrink with slothful indifference from the great struggle of rival nations in the career of the industrial arts. It is with nations as with Nature, which, according to a happy expression of Goethe, "knows no pause in progress and development, and attaches her curse on all inaction." The propagation of an earnest and sound knowledge of science can therefore alone avert the dangers of which I have spoken. Man cannot act upon Nature, or appropriate her forces to his own use, without comprehending their full extent and having an intimate acquaintance with the laws of the physical world.—HUMBOLDT *Cosmos*, vol. i, int., p. 53. (H., 1897.)

2769. PROTECTION BY DESTRUCTION OF ENEMIES— *The Sparrow-hawk Devours Destroyers of Crops.*—The sparrow-hawk has a perfectly clean record, as far as chickens go, not one of the 320 whose stomachs were examined by Dr. Fisher having partaken of poultry, while no less than 215 had eaten insects and 89 had captured mice. Grasshoppers are the sparrow-hawk's chief food, and we may often see him hovering over the fields with rapidly moving wings. Then, dropping lightly down on some unsuspecting victim below, he returns to the bare limb or stub he uses for a lookout station, uttering an exultant *killy—killy—killy* as he flies.—CHAPMAN *Bird-Life*, ch. 7, p. 120. (A., 1900.)

2770. PROTECTION BY DISTASTEFULNESS — *Even Parasites Avoid the Monarch Butterfly.*—Mr. Samuel H. Scudder, who has largely bred North-American butterflies, has found so many of the eggs and larvæ destroyed by hymenopterous and dipterous parasites that he thinks at least nine-tenths, perhaps a greater proportion, never reach maturity. Yet he has never found any evidence that such parasites attack either the egg or the larva of the inedible *Danais archippus*, so that in this case the insect is distasteful to its most dangerous foes in all the stages of its existence, a fact which serves to explain its great abundance and its extension over almost the whole world.—WALLACE *Darwinism*, ch. 9, p. 161. (Hum., 1897.)

2771. PROTECTION BY MIMICRY— *Spiders Resembling Leaves Both in Action and Appearance.*—Green-leafed bushes are frequented by vividly green epeiras [spiders], but the imitative resemblance does not quite end here. The green spider's method of escape, when the bush is roughly shaken, is to drop itself down on the earth where it lies simulating death. In falling, it drops just as a green leaf would drop, that is, not quite so rapidly as a round, solid body like a beetle or a spider. Now in the bushes there is another epeira, in size and form like the last, but differing in color; for instead of a vivid green it is of a faded yellowish white—the exact hue of a dead, dried-up leaf. This spider, when it lets itself drop—for it has the same protective habit as the other—falls not so rapidly as a green freshly broken-off leaf, or as the green spider would fall, but with a slower motion, precisely like a leaf withered up till it has become almost light as a

feather. It is not difficult to imagine how this comes about: either a thicker line, or a greater stiffness or tenacity of the viscid fluid composing the web and attached to the point the spider drops from, causes one to fall slower than the other.—HUDSON *Naturalist in La Plata*, ch. 14, p. 182. (C. & H., 1895.)

2772. PROTECTION IMPOSSIBLE IF NATURAL LAW NEGLECTED—*Guardian Leucocytes Powerless To Save an Enfeebled or Corrupted Organism.*—It seems probable, and, in fact, almost certain, that so long as we live in tolerably healthy conditions, these leucocytes [or white corpuscles of the blood] are able to deal with all disease-germs which can gain access to our system; but when we live in impure air, or drink impure water, or feed upon unwholesome food, our system becomes enfeebled and our guardian leucocytes are unable to destroy the disease-germs that gain access to our organism; they then increase rapidly, and are in many cases able to destroy us.—WALLACE *The Wonderful Century*, ch. 14, p. 145. (D. M. & Co., 1899.)

2773. PROTECTION OF ALPINE PLANTS BY SNOW—*The Greenhouse Proves a Fitting Substitute.*—The most striking illustration of the protection which a covering of snow affords against cold is furnished by the way in which it was at last found possible to naturalize in gardens on the continent of Europe some of the peculiarly beautiful and brilliantly colored plants of the Alpine regions, which it had often been attempted to naturalize in vain. During the winter they always died, till an ingenious gardener hit upon the device of affording them artificially the protection against cold which in their native seats they regularly obtain from their covering of snow. He did so by putting them in the greenhouses along with the orange and pomegranate trees of warmer climates, and his experiment was crowned with success. The protection which snow affords against cold is perhaps the most important function that it fulfils in the economy of Nature, but it is not its only function, nor its only important function.—CHISHOLM *Nature-Studies*, p. 30. (Hum., 1888.)

2774. PROTECTION OF EARTH BY VEIL OF VAPOR—*Freezing Power of Radiation through Dry Air.*—A freedom of escape, similar to that from bodies of vapor at great elevations, would occur at the earth's surface generally were the aqueous vapor removed from the air above it; for the great body of the atmosphere is a practical vacuum as regards the transmission of radiant heat. The withdrawal of the sun from any region over which the atmosphere is dry must be followed by quick refrigeration. The removal, for a single summer night, of the aqueous vapor from the atmosphere which covers England would be attended by the destruction of every plant which a freezing temperature could kill. The moon would be rendered entirely uninhabitable by beings like ourselves through the operation of this single cause. With a radiation uninterrupted by aqueous vapor the difference between her monthly maxima and minima must be enormous. The winters of Tibet are almost unendurable. Witness how the isothermal lines dip from the north into Asia, in winter, as a proof of the low temperature of this region. Humboldt has dwelt upon the "frigorific power" of the central portions of this continent, and controverted the idea that it was to be explained by reference to the elevation, there being vast expanses of country, not much above the sea-level, with an exceedingly low temperature. But not knowing the influence which we are now studying, Humboldt, I imagine, omitted the most potent cause of the cold. The refrigeration at night is extreme because the air is dry. In Sahara, where "the soil is fire and the wind is flame," the cold at night is often painful to bear.—TYNDALL *Heat a Mode of Motion*, lect. 13, p. 385. (A., 1900.)

2775. PROTECTION OF LABOR—*Natural Laws Inadequate—Positive Enactments Needed—The Old English Apprenticeship.*—And now for the first time appeared some of the consequences of gregarious labor under the working of natural laws, and under no restrictions from positive institution. The mill-owners collected as apprentices boys and girls, and youths and men, and women, of all ages. In very many cases no provision adequate, or even decent, was provided for their accommodation. The hours of labor were excessive. The ceaseless and untiring agency of machines kept no reckoning of the exhaustion of human nerves. The factory system had not been many years in operation when its effects were seen. A whole generation were growing up under conditions of physical degeneracy, of mental ignorance, and of moral corruption.

The first public man to bring it under the notice of Parliament with a view to remedy was, to his immortal honor, a master manufacturer, to whom the new industry had brought wealth and power and station. In 1802 the elder Sir Robert Peel was the first to introduce a bill to interfere by law with the natural effects of unrestricted competition in human labor.—ARGYLL *Reign of Law*, ch. 7, p. 207. (Burt.)

2776. PROTECTION OF TREE AGAINST LOSS OF HEAT—MM. De la Rive and De Candolle have remarked upon the influence which its feeble conducting power in a lateral direction must exert, in preserving within a tree the warmth which it acquires from the soil. But Nature has gone farther and clothes the tree with a sheathing of worse conducting material than the wood itself, even in its worst direction [viz., the bark].—TYNDALL *Heat a Mode of Motion*, lect. 9, p. 253. (A., 1900.)

2777. PROTECTION, PRECIOUSNESS OF THE DIVINE—*Human Littleness and Insecurity.*—Now, it is this littleness and this insecurity which make the protection of the Almighty so dear to us, and bring, with such emphasis, to every pious bosom the holy lessons of humility and gratitude. The God who sitteth above, and presides in high authority over all worlds, is mindful of man; and tho at this moment his energy is felt in the remotest provinces of creation, we may feel the same security in his providence as if we were the objects of his undivided care. It is not for us to bring our minds up to this mysterious agency. But such is the incomprehensible fact that the same Being, whose eye is abroad over the whole universe, gives vegetation to every blade of grass, and motion to every particle of blood which circulates through the veins of the minutest animal; that, tho his mind takes into its comprehensive grasp immensity and all its wonders, I am as much known to him as if I were the single object of his attention; that he marks all my thoughts; that he gives birth to every feeling and every movement within me, and that, with an exercise of power which I can neither describe nor comprehend, the same God who sits in the highest heaven and reigns over the glories of the firmament is at my right hand, to give me every breath which I draw and every comfort which I enjoy.—CHALMERS *Astronomical Discourses*, p. 39. (R. Ct., 1848.)

2778. PROTECTION SECURED BY THE "SLEEP" OF PLANTS—*Saving Upper Surface of Leaf from Radiation the Object Gained.*—The fact that the leaves of many plants place themselves at night in widely different positions from what they hold during the day, but with the one point in common that their upper surfaces avoid facing the zenith, often with the additional fact that they come into close contact with opposite leaves or leaflets, clearly indicates, as it seems to us, that the object gained is the protection of the upper surfaces from being chilled at night by radiation. There is nothing improbable in the upper surface needing protection more than the lower, as the two differ in function and structure. All gardeners know that plants suffer from radiation. It is this and not cold winds which the peasants of Southern Europe fear for their olives. Seedlings are often protected from radiation by a very thin covering of straw, and fruit-trees on walls by a few fir branches, or even by a fishing-net, suspended over them.—DARWIN *Power of Movement in Plants*, ch. 6, p. 284. (A., 1900.)

2779. PROTECTION THE CHIEF CARE OF NESTING BIRDS—The first step in nest-building is the selection of a site. There is almost no suitable location, from a hole in the ground to branches in the tree-tops, in which birds may not place their nests. Protection seems to be the chief desideratum, and this is generally secured through concealment. Most birds hide their nests. Many sea-birds, however, lay their eggs on the shores or cliffs, with no attempt at concealment; but, as a rule, birds that nest in this manner resort to uninhabited islets and secure protection through isolation. Some birds nest alone and jealously guard the vicinity of their home from the approach of other birds, generally of the same species. Others nest in colonies brought together by temperament or community of interests, and dwell on terms of the closest sociability.—CHAPMAN *Bird-Life*, ch. 5, p. 65. (A., 1900.)

2780. PROVISION OF NATURE FOR MAN—*The Bamboo.*—Almost all tropical countries produce bamboos, and wherever they are found in abundance the natives apply them to a variety of uses. Their strength, lightness, smoothness, straightness, roundness, and hollowness, the facility and regularity with which they can be split, their many different sizes, the varying length of their joints, the ease with which they can be cut, and with which holes can be made through them, their hardness outside, their freedom from any pronounced taste or smell, their great abundance, and the rapidity of their growth and increase, are all qualities which render them useful for a hundred different purposes, to serve which other materials would require much more labor and preparation. The bamboo is one of the most wonderful and most beautiful productions of the tropics, and one of Nature's most valuable gifts to uncivilized man. [Quoted from Wallace, "Malay Archipelago."]—MASON *Origins of Invention*, ch. 6, p. 209. (S., 1899.)

2781. PSEUDO-SCIENCE—*Comte's Second-hand Knowledge.*—As I have said, that part of M. Comte's writings which deals with the philosophy of physical science appeared to me to possess singularly little value, and to show that he had but the most superficial and merely second-hand knowledge of most branches of what is usually understood by science. I do not mean by this merely to say that Comte was behind our present knowledge, or that he was unacquainted with the details of the science of his own day. No one could justly make such defects cause of complaint in a philosophical writer of the past generation. What struck me was his want of apprehension of the great features of science; his strange mistakes as to the merits of his scientific contemporaries, and his ludicrously erroneous notions about the part which some of the scientific doctrines current in his time were destined to play in the future.—HUXLEY *Lay Sermons*, serm. 8, p. 147. (A., 1895.)

2782. PSYCHOLOGY EXPERIMENTAL—*Not Advanced by Hypnotism.*—It must, moreover, be plain to you all that there

can be no question of an experimental psychological method, in the exact sense of those words, in this matter of hypnotizing. The condition of hypnosis is such as absolutely to preclude the possibility of a psychological experiment in the real sense. The psychological experiment demands from its subject concentration of the attention, practise, skilled introspection—in short, the fulfilment of all manner of conditions, which, if not altogether and normally out of the reach of the hypnotic subject, is at least wholly impossible during the course of the induced sleep. If we compose ourselves to sleep with the intention of observing our dreams, so far as that is possible, or even if we take morphin for the same purpose, we are not making an experiment, not doing anything that in execution or result is essentially different from simple observation. The conditions of dream observation are not altered in the slightest degree by the fact that we have brought on sleep intentionally. The characteristics of the experimental method are variation and gradation of the phenomena, and elimination of certain conditions. Such a mode of procedure can be followed out in artificially induced sleep as little—or, let us say, as imperfectly—as in natural sleep; we shall gain no more by investigating the former than by collecting casual observations of normal dreams. And all this holds in still greater measure of hypnotism, since just in the cases which present the most interesting phenomena there is a total absence of any subsequent recollection. We can only infer what goes on in the mind of the somnambulist from his words and actions; if we wish to subject him to special influences we are hampered by the same conditions as hinder the investigation of sleep and dreams.—WUNDT *Psychology*, lect. 22, p. 336. (Son. & Co., 1896.)

2783. PSYCHOLOGY EXPLAINING SOCRATES—*Heroism and Self-devotion Defy Analysis—Character Known by Experience and Sympathy.*—We can say that Socrates remained in the prison because his knee muscles were contracted in a sitting position and not working to effect his escape, and that these muscle processes took place because certain psychophysical ideas, emotions, and volitions, all composed of elementary sensations, occurred in his brain, and that they, again, were the effect of all the causes which sense stimulations and dispositions, associations, and inhibitions, physiological and climatic influences, produced in that organism. And we can say, on the other hand, that Socrates remained in the prison because he decided to be obedient to the laws of Athens unto death. This obedience means, then, not a psychophysical process, but a will attitude which we must understand by feeling it and living through it, an attitude which we cannot analyze, but which we interpret and appreciate. The first is a psychological description; the second is an historical interpretation. . . . And yet both are equally true, while they blend into an absurdity if we say that those psychophysical states in the brain of Socrates were the objects which inspired the will of his pupils, and were suggestive through two thousand years.—MÜNSTERBERG *Psychology and Life*, p. 219. (H. M. & Co., 1899.)

2784. PSYCHOLOGY, FANTASIES OF COMPARATIVE METHOD IN—*Wild Statements about Children and Savages.*—There are great sources of error in the comparative method. The interpretation of the "psychoses" of animals, savages, and infants is necessarily wild work, in which the personal equation of the investigator has things very much its own way. A savage will be reported to have no moral or religious feeling if his actions shock the observer unduly. A child will be assumed without self-consciousness because he talks of himself in the third person, etc., etc. No rules can be laid down in advance. Comparative observations, to be definite, must usually be made to test some preexisting hypothesis; and the only thing, then, is to use as much sagacity as you possess, and to be as candid as you can.—JAMES *Psychology*, vol. i, ch. 7, p. 194. (H. H. & Co., 1899.)

2785. PSYCHOLOGY IN THE SCHOOLROOM—*Science Limited by an Incalculable Element—The Unknown Mind of an Opponent.*—The science of psychology, and whatever science of general pedagogics may be based on it, are, in fact, much like the science of war. Nothing is simpler or more definite than the principles of either. In war all you have to do is to work your enemy into a position from which the natural obstacles prevent him from escaping if he tries to; then to fall on him in numbers superior to his own, at a moment when you have led him to think you far away; and so, with a minimum of exposure of your own troops, to hack his force to pieces, and take the remainder prisoners. Just so, in teaching, you must simply work your pupil into such a state of interest in what you are going to teach him that every other object of attention is banished from his mind; then reveal it to him so impressively that he will remember the occasion to his dying day; and finally fill him with devouring curiosity to know what the next steps in connection with the subject are. The principles being so plain, there would be nothing but victories for the masters of the science, either on the battle-field or in the schoolroom, if they did not both have to make their application to an incalculable quantity in the shape of the mind of their opponent. —JAMES *Talks to Teachers*, ch. 1, p. 9. (H. H. & Co., 1900.)

2786. ——— ——— *Teacher Deals with Mental Life; Not with Brain Processes and Ganglion-cells—Pedagogy Independent of*

Psychological Problems.—The case of physiological psychology is the simplest one. There was never a teacher who would have taught otherwise, or would have changed his educational efforts, if the physiological substratum of the mental life had been the liver or the kidneys instead of the brain. . . . It is a caricature of the facts if you tell the teacher that he can learn anything new about the mental life if he knows by heart the accompanying brain processes; and if the teacher, in the hope of understanding the mental life of children better, studies the ganglion-cells under the microscope, he could substitute just as well the reading of Egyptian hieroglyphics.—MÜNSTERBERG *Psychology and Life,* p. 129. (H. M. & Co., 1899.)

2787. PSYCHOLOGY MUST BEGIN WITH FACTS OF CONSCIOUSNESS—*Experience As Compared with Reflection.*—If it be sensation, feeling, idea, and will which led in the first instance to the assumption of mind, the only natural method of psychological investigation will be that which begins with just these facts. First of all, we must understand their empirical nature, and then go on to reflect upon them. For it is experience and reflection which constitute each and every science. Experience comes first; it gives us our bricks; reflection is the mortar which holds the bricks together. We cannot build without both. Reflection apart from experience, and experience without reflection, are alike powerless. It is therefore essential for scientific progress that the sphere of experience be enlarged, and new instruments of reflection from time to time invented.—WUNDT *Psychology,* lect. 1, p. 8. (Son. & Co., 1896.)

2788. PSYCHOLOGY, NOTHING NEW IN ESSENTIALS OF—There is no "new psychology" worthy of the name. There is nothing but the old psychology which began in Locke's time, plus a little physiology of the brain and senses and theory of evolution, and a few refinements of introspective detail.—JAMES *Talks to Teachers,* ch. 1, p. 7. (H. H. & Co., 1900.)

2789. PUGNACITY USEFUL—*The Fighting Impulse Needed to Conquer Difficulties.*—Pugnacity need not be thought of merely in the form of physical combativeness. It can be taken in the sense of a general unwillingness to be beaten by any kind of difficulty. It is what makes us feel "stumped" and challenged by arduous achievements, and is essential to a spirited and enterprising character. We have of late been hearing much of the philosophy of tenderness in education; "interest" must be assiduously awakened in everything, difficulties must be smoothed away. *Soft* pedagogies have taken the place of the old steep and rocky path to learning. But from this lukewarm air the bracing oxygen of effort is left out. It is nonsense to suppose that every step in education *can* be interesting. The fighting impulse must often be appealed to. Make the pupil feel ashamed of being scared at fractions, of being "downed" by the law of falling bodies; rouse his pugnacity and pride, and he will rush at the difficult places with a sort of inner wrath at himself that is one of his best moral faculties. A victory scored under such conditions becomes a turning-point and crisis of his character. It represents the high-water mark of his powers, and serves thereafter as an ideal pattern for his self-imitation.—JAMES *Talks to Teachers,* ch. 7, p. 54. (H. H. & Co., 1900.)

2790. PUNCTUALITY ESSENTIAL IN SCIENTIFIC OBSERVATIONS—*Eclipse To Be Recommenced—Story of Cassini.*—It is necessary to catch them [eclipses] on the wing, so to say, and not to imitate the too presumptuous marquis of the time of Louis XV. when conducting to the observatory a party of fashionable ladies, and who, having been a little delayed by the petty cares of the toilet, arrived half a minute after the end of the eclipse. As the ladies refused to alight from their coach, a little displeased by the unreasonableness of coquetry, "Let us all go in, ladies," cried the little dandy, with the most haughty assurance; "M. de Cassini is one of my best friends, and he will have real pleasure in recommencing the eclipse for us!" This anecdote has been retold in our century on the authority of Arago.—FLAMMARION *Popular Astronomy,* bk. ii, ch. 9, p. 194. (A.)

2791. PURIFICATION OF THE ATMOSPHERE—*Deadly Gas Made to Sustain Life.*—Consider, then, all the fires in the world and all the animals in the world continually pouring their carbonic acid into the atmosphere. Would it not be fair to conclude that our air must become more and more contaminated, and unfit to support either combustion or life? This seems inevitable, but it would be a conclusion founded upon half-knowledge, and therefore wrong. A provision exists for continually purifying the atmosphere of its excess of carbonic acid. By the leaves of plants this gas is absorbed, and within the leaves it is decomposed by the solar rays. The carbon is stored up in the tree, while the pure oxygen is restored to the atmosphere. Carbonic acid, in fact, is to a great extent the nutriment of plants; and inasmuch as animals, in the long run, derive their food from the vegetable world, this very gas, which at first sight might be regarded as a deadly constituent of the atmosphere, is the main sustainer both of vegetable and animal life. —TYNDALL *Heat a Mode of Motion,* lect. 3, p. 55. (A., 1900.)

2792. PURITY, APPARENT, NOT ALWAYS REAL—*Bacteria Float in Transit through the Air—Often Where Least Expected.*—There is no numerical standard for

bacteria in the air, as there is in water. The open air possibly averages about 250 per cubic meter. On the seacoast this number would fall to less than half; in houses and towns it would rise according to circumstances, and frequently in dry weather reach thousands per cubic meter. When it is remembered *that air possesses no pabulum* for bacteria, as do water and milk, it will be understood that bacteria do not live in the air. They are only driven by air-currents from one dry surface to another. Hence the quality and quantity of air organisms depend entirely upon environment and physical conditions. In some researches which the writer made into the air of workshops in Soho in 1896, it was instructive to observe that fewer bacteria were isolated by Sedgwick's sugar-tube in premises which appeared to the naked eye polluted in a large degree than in other premises apparently less contaminated. In the workroom of a certain skin-curer the air was densely impregnated with particles from the skin, yet scarcely a single bacterium was isolated. In the polishing-room of a well-known hat firm, in which the air appeared to the naked eye to be pure, and in which there was ample ventilation, there were found four or five species of saprophytic bacteria.—Newman *Bacteria*, ch. 3, p. 107. (G. P. P., 1899.)

2793. PURITY IS SAFETY—*Germless Air Produces No Putrefaction nor Disease.*—During the ten years extending from 1859 to 1869 researches on radiant heat in its relations to the gaseous form of matter occupied my continual attention. When air was experimented on I had to cleanse it effectually of floating matter, and while doing so I was surprised to notice that, at the ordinary rate of transfer, such matter passed freely through alkalis, acids, alcohols, and ethers. The eye being kept sensitive by darkness, a concentrated beam of light was found to be a most searching test for suspended matter both in water and in air—a test, indeed, indefinitely more searching and severe than that furnished by the most powerful microscope. With the aid of such a beam I examined air filtered by cotton-wool, air long kept free from agitation, so as to allow the floating matter to subside; calcined air and air filtered by the deeper cells of the human lungs. In all cases the correspondence between my experiments and those of Schwann, Schroeder, Pasteur, and Lister in regard to spontaneous generation was perfect. The air which they found inoperative was proved by the luminous beam to be optically pure and therefore germless.—Tyndall *Floating Matter of the Air*, essay 5, p. 288. (A., 1895.)

2794. PURITY, RELATIVE, OF ANIMAL FOOD—*Meat Rarely Contains Bacteria.*—Parasites are occasionally found in meat, but bacteria are comparatively rare. Not that they do not occur in the bodies of animals used for human consumption, for in the glands, mesenteries, and other organs they are common. But in those portions of the carcass which are used by man, namely, the muscles, bacteria are rare. The reasons alleged for this are the acid reaction (sarcolactic acid) and the more or less constant movement during life. A bacterial disease which, perhaps more than any other, might be expected to be conveyed by meat is tubercle. Yet the recent Royal Commission on Tuberculosis has again emphasized the absence of bacilli in the meat substance.—Newman *Bacteria*, ch. 6, p. 234. (G. P. P., 1899.)

2795. PURPOSE, APPARENT, IN REFLEX ACTION—*The Brainless Frog.*—In observing the effects, and in reading accounts of the effects, of what is called "reflex action" in the animal economy, and before I had submitted the phrase to strict analysis, I had long felt that sense of confusion which results from the presentation to the mind of false analogies, of incompetent description, and of formulæ of expression which, pretending to be scientific, are in reality nothing but the wilful shutting-out of knowledge. It is, however, most satisfactory to find that in one of the latest and best text-books of physiology, that of Professor Forster of Cambridge, there is a full confession of the incompetency of such words as "reflex action" to describe the relation between the stimulus of an "afferent" nerve and the "efferent" movements which are carried into responsive preadjusted action. The two classes of impulse and of resulting movement are justly described as really "incommensurate." And whilst the purely mechanical or physical relation of mere bending or turning is thus condemned not only as an inadequate, but as essentially a false image of the real relation which subsists between the antecedent and the consequent phenomena, that real relation is described and admitted in the following remarkable passage: "In the more complex reflex actions of the brainless frog, and in other cases, the relation is of such a kind as that the resulting movement bears *an adaptation* to the stimulus; the foot is withdrawn from the stimulus, or the movement is calculated to push or wipe away the stimulus. In other words, a certain purpose is evident in the reflex action."—Argyll *Unity of Nature*, ch. 8, p. 302. (Burt.)

2796. PURPOSE IN NATURE—*Beauty and Utility of Dust.*—Let us now briefly summarize what we owe to the universality of dust, and especially to that most finely divided portion of it which is constantly present in the atmosphere up to the height of many miles. First of all, it gives us the pure blue of the sky, one of the most exquisitely beautiful colors in Nature. It gives us also the glories of the sunset and the sunrise, and all those brilliant hues seen in high mountain regions. Half the beauty of the world would vanish with the absence

of dust. But, what is far more important than the color of sky and beauty of sunset, dust gives us also diffused daylight, or sky-light, that most equable and soothing and useful of all illuminating agencies. Without dust the sky would appear absolutely black, and the stars would be visible even at noonday. The sky itself would, therefore, give us no light. We should have bright, glaring sunlight or intensely dark shadows, with hardly any half-tones. From this cause alone the world would be so totally different from what it is that all vegetable and animal life would probably have developed into very different forms, and even our own organization would have been modified in order that we might enjoy life in a world of such harsh and violent contrasts.—WALLACE *The Wonderful Century*, ch. 9, p. 82. (D. M. & Co., 1899.)

2797. ——— ——— *Law of Structure Subordinate to Law of Purpose—Man and Gorilla.*—Professor Huxley, in his work on "Man's Place in Nature," has endeavored to prove that, so far as mere physical structure is concerned, "the differences which separate him from the gorilla and the chimpanzee are not so great as those which separate the gorilla from the lower apes." On the frontispiece of this work he exhibits in series the skeletons of the anthropoid apes and of man. It is a grim and grotesque procession. The form which leads it, however like the others in general structural plan, is wonderfully different in those lines and shapes of matter which have such mysterious power of expressing the characters of mind. And significant as those differences are in the skeleton, they are as nothing to the differences which emerge in the living creatures. Huxley himself admits that these differences amount to "an enormous gulf," to a "divergence immeasurable —practically infinite." What more striking proof could we have than this, that organic forms are but as clay in the hands of the potter, and that the "law of structure" is entirely subordinate to the "law" of purpose and intention under which the various parts of that structure are combined for use?—ARGYLL *Reign of Law*, ch. 5, p. 157. (Burt.)

2798. ——— ——— *Manifold Adaptations—One Design No Disproof of Another—Adaptation of Grain both to Reproduction and to Food.*—To perceive intention is a very different thing from perceiving all that is intended. Our own human experience should make this distinction familiar to us. Many things we do and many things we contrive are done and contrived with more than one intention. In the light of this experience it is altogether irrational to regard as an exception to the attainment of purpose in Nature the fact, for example, "that of fifty seeds she often brings but one to bear." It throws no doubt or difficulty in the way of our conviction, for example, that one purpose of seed-bearing in plants is the reproduction of their kind, because it appears that another purpose to which that seed-bearing is applied is the support of animal life. The intention with which a grain of wheat is so constituted as to be capable of producing another wheat plant is not the less in the nature of purpose because it coexists with another intention, that the same grain should be capable of sustaining the powers and the enjoyments of life in the body and in the mind of man. On the contrary, the power possessed by most plants, and by this plant especially, of producing seed in a ratio far beyond that which would be required for one purpose, is the sure indication and the proof that another purpose larger and wider was in view.—ARGYLL *Reign of Law*, ch. 4, p. 104. (Burt.)

2799. ——— ——— *Movement of Leaves of Plants.*—As the upward movements of the leaflets of *Robinia*, and the downward movements of those of *Oxalis*, have been proved to be highly beneficial to these plants when subjected to bright sunshine, it seems probable that they have been acquired for the special purpose of avoiding too intense an illumination.—DARWIN *Power of Movement in Plants*, ch. 8, p. 453. (A., 1900.)

2800. ——— ——— *Plain Coloring of Female Birds—Final Not Identical with Physical Cause.*—Utility, indeed, in a different sense, can be quoted with probability, as accounting for the comparative plain coloring of females in this and in almost all other genera of birds. But then it is utility conceived as operating by way of motive in a creative mind, and not operating as a physical cause in the production of a mechanical result. And here we find Mr. Wallace instinctively testifying to this great distinction, and employing language which indicates the passage from one order of ideas to another. He says, "The reason why female birds are not adorned with equally brilliant plumes is sufficiently clear; they would be injurious by rendering their possessors too conspicuous during incubation." [*Quarterly Journal of Science*, October, 1867, p. 481.] This is, no doubt, the true explanation of the purpose which the plain coloring of female birds is intended to serve; but it is no explanation at all of the physical causes by which this special protection is secured.—ARGYLL *Reign of Law*, ch. 5, p. 137. (Burt.)

2801. ——— ——— *The Extermination of Useless Organisms.*—Nature is purposeful, not only in adapting recently developed structures to her uses—*i. e.*, in fitting them to perform properly the functions allotted to them—but conversely, in removing everything superfluous, so that as soon as a structure is no longer required it is eliminated. Of course, this elimination is neither sudden nor voluntary, but comes to pass

gradually, in accordance with certain laws, so that we are often able to watch every stage of the transition from the full development of an organ to the entire absence of it.—WEISMANN *Heredity,* vol. ii, ch. 9, p. 6. (Cl. P., 1891.)

2802. ——— ——— *The Key to Structure—How Darwin "Neglected This Plain Guide."*—The idea of special use, as the controlling principle of construction, is so impressed on Mr. Darwin's mind that in every detail of structure, however singular or obscure, he has absolute faith that in this lies the ultimate explanation. If an organ is largely developed, it is because some special purpose is to be fulfilled. If it is aborted or rudimentary, it is because that purpose is no longer to be subserved. In the case of another species whose structure is very singular Mr. Darwin had great difficulty in discovering how the mechanism was meant to work so as to effect the purpose. At last he made it out, and of the clue which led to the discovery he says: "The strange position of the labellum perched on the summit of the column ought to have shown me that here was the place for experiment. I ought to have scorned the notion that the labellum was thus placed *for no good purpose.* I neglected this plain guide, and for a long time completely failed to understand the flower." ["Fertilization of Orchids," p. 262.]—ARGYLL *Reign of Law,* ch. 1, p. 23. (Burt.)

2803. PURPOSE, MANIFESTED BY MONKEY—I observed to-day that if a nut or any object he [a capuchin monkey] wishes to get hold of is beyond the reach of his chain he puts out a stick to draw it towards him, or, if that does not succeed, he stands upright and throws a shawl back over his head, holding it by the two corners so that it falls down his back; he then throws it forward with all his strength, still holding on by the corners; thus it goes out far in front of him and covers the nut, which he then draws towards him by pulling in the shawl. When his chain becomes twisted round the bars of a "clothes-horse" (which is given him to run about upon), and thus too short for his comfort, he looks at it intently and pulls it with his fingers this way and that, and when he sees how the turns are taken he deliberately goes round and round the bars, first this way, then that, until the chain is quite disentangled.—ROMANES *Animal Intelligence (extract from diary of author's sister),* ch. 17, p. 486. (A., 1899.)

2804. PURPOSE MISUNDERSTOOD—*Bird Not Buoyed Up by Air-cells—Why the Bird's Bones Are Hollow.*—The common explanation of birds being assisted by air-cells for the inhalation and storage of heated air must not only be erroneous, but founded on wholly false conceptions of the fundamental mechanical principles on which flight depends. If a bird could inhale enough warm air to make it buoyant, its power of flight would be effectually destroyed. It would become as light as a balloon, and consequently as helpless. If, on the other hand, it were merely to inflate itself with a small quantity of hot air insufficient to produce buoyancy, but sufficient to increase its bulk, the only effect would be to expose it to increased resistance in cleaving the air. It is true, indeed, that the bones of birds are made more hollow and lighter than the bones of mammals, because birds, tho requiring weight, must not have too much of it. It is true, also, that the air must have access to these hollows, else they would be unable to resist atmospheric pressure. But it is no part whatever of the plan or intention of the structure of birds, or of any part of that structure, to afford balloon-space for heated air with a view to buoyancy.—ARGYLL *Reign of Law,* ch. 3, p. 87. (Burt.)

2805. PURPOSE OF CIRCULATION ON THE SUN—*The Reverse of That on the Earth.*—The solar system of circulation, instead of being adapted, like that of the earth, to the distribution of heat received from without, was seen to be directed towards the transportation towards the surface of the heat contained within. Polar and equatorial currents, tending to a purely superficial equalization of temperature, were replaced by vertical currents bringing up successive portions of the intensely heated interior mass, to contribute their share in turn to the radiation into space which might be called the proper function of a sun.—CLERKE *History of Astronomy,* pt. ii, ch. 2, p. 187. (Bl., 1893.)

2806. PURPOSE, SELECTIVE, OF HONEY-BEE—*Plan Changed to Meet Difficulties.*—Finally, in places where special conditions of the situation do not otherwise permit, it may be observed that the bees, far from clinging obstinately to their plan, very well understand how to accommodate themselves to circumstances not only in cell-building, but also in making their combs. F. Huber tried to mislead their instinct, or rather to put to the proof their reason and cleverness in every possible way, but they always emerged triumphant from the ordeal. For instance, he put bees in a hive the floor and roof of which were made of glass, that is, of a body which the bees use very unwillingly for the attachment of their combs on account of its smoothness. Thus the possibility of building as usual from above downwards, and also from below upwards, was taken away from them; they had no point of support save the perpendicular walls of their dwelling. They thereupon built on one of these walls a regular stratum of cells, from which, building sideways, they tried to carry the comb to the opposite side of the hive To prevent this, Huber covered that side also with glass. But what way out of the difficulty was found by the clever

insects? Instead of building further in the projected direction they bent the comb round at the extreme point, and carried it at a right angle towards one of the inner sides of the hive which was not covered with glass, and there fastened it. The form and dimensions of the cells must necessarily have been altered thereby, and the arrangement of their work at the angle must have been quite different from the usual. They made the cells of the convex side so much broader than those of the concave that they had a diameter two or three times as great, and yet they managed to join them properly with the others. They also did not wait to bend the comb until they came to the glass itself, but recognized the difficulty beforehand, which had been interposed by Huber while they were building with a view to overcome the first difficulty.—ROMANES *Animal Intelligence*, ch. 4, p. 177. (A., 1899.)

2807. PURPOSE THE MARK OF MIND—*Theist vs. Atheist and Materialist.*—*The pursuance of future ends and the choice of means for their attainment are the mark and criterion of the presence of mentality* in a phenomenon. We all use this test to discriminate between an intelligent and a mechanical performance. We impute no mentality to sticks and stones, because they never seem to move for *the sake of* anything, but always when pushed, and then indifferently and with no sign of choice. So we unhesitatingly call them senseless. Just so we form our decision upon the deepest of all philosophic problems: Is the Kosmos an expression of intelligence rational in its inward nature, or a brute external fact pure and simple? If we find ourselves, in contemplating it, unable to banish the impression that it is a realm of final purposes, that it exists for the sake of something, we place intelligence at the heart of it and have a religion. If, on the contrary, in surveying its irremediable flux, we can think of the present only as so much mere mechanical sprouting from the past, occurring with no reference to the future, we are atheists and materialists.—JAMES *Psychology*, vol. i, ch. 1, p. 8. (H. H. & Co., 1899.)

2808. PURPOSE WROUGHT OUT IN DISCOVERY OF AMERICA—*The Result of Scientific Thought.*—Wholly different from the first discovery of the New Continent in the eleventh century, its rediscovery by Christopher Columbus and his explorations of the tropical regions of America have been attended by events of cosmical importance, and by a marked influence on the extension of physical views. Altho the mariners who conducted this great expedition at the end of the fifteenth century were not actuated by the design of attempting to discover a new quarter of the world, and altho it would appear to be proved that Columbus and Amerigo Vespucci died in the firm conviction that they had merely touched on portions of Eastern Asia, yet the expedition manifested the perfect character of being the fulfilment of a plan sketched in accordance with scientific combinations. The expedition was safely conducted westward, through the gate opened by the Tyrians and Colæus of Samos, across the immeasurable dark sea, *mare tenebrosum*, of the Arabian geographers. They strove to reach a goal, with the limits of which they believed themselves acquainted. They were not driven accidentally thither by storms, as Naddod and Gardar had been borne to Iceland, and Gunlijörn to Greenland.—HUMBOLDT *Cosmos*, vol. ii, pt. ii, p. 238. (H., 1897.)

2809. PURSUIT OF THE TYPE—*The Struggle of Nature—The Ideal of Christianity.*—We have been dealing with Christianity at its most mystical point. Mark here once more its absolute naturalness. The pursuit of the type is just what all Nature is engaged in. Plant and insect, fish and reptile, bird and mammal—these in their several spheres are striving after the type. To prevent its extinction, to ennoble it, to people earth and sea and sky with it—this is the meaning of the struggle for life. And this is our life—to pursue the type, to populate the world with it.—DRUMMOND *Natural Law in the Spiritual World*, essay 8, p. 279. (H. Al.)

2810. PUTREFACTION IMPOSSIBLE IN GERMLESS AIR—*Experiments of Schwann.*—Schwann placed flesh in a flask filled to one-third of its capacity with water, sterilized the flask by boiling, and then supplied it for months with calcined air. Throughout this time there appeared no mold, no infusoria, no putrefaction: the flesh remained unaltered, while the liquid continued as clear as it was immediately after boiling. Schwann then varied his experimental argument, with no alteration in the result. His final conclusion was that putrefaction is due to decompositions of organic matter attendant on the multiplication therein of minute organisms. These organisms were derived not from the air, but from something contained in the air, which was destroyed by a sufficiently high temperature.—TYNDALL *Floating Matter of the Air*, p. 282. (A., 1895.)

2811. QUALIFICATIONS OF ARABS FOR SCIENTIFIC RESEARCH—The Arabs possessed remarkable qualifications alike for appropriating to themselves, and again diffusing abroad, the seeds of knowledge and general intercourse, from the Euphrates to the Guadalquivir, and to the south of Central Africa. They exhibited an unparalleled mobility of character, and a tendency to amalgamate with the nations whom they conquered, wholly at variance with the repelling spirit of the Israelitish castes, while, at the same time, they adhered to their national character, and the traditional recollections of their original home, notwith-

standing their constant change of abode. No other race presents us with more striking examples of extensive land journeys, undertaken by private individuals, not only for purposes of trade, but also with the view of collecting information, surpassing in these respects the travels of the Buddhist priests of Tibet and China, Marco Polo, and the Christian missionaries, who were sent on an embassy to the Mongolian princes.—HUMBOLDT *Cosmos*, vol. ii, pt. ii, p. 212. (H., 1897.)

2812. QUALIFICATIONS OF GREAT SCIENTIST—*Kepler—Imaginative Power Joined with Accuracy of Observation.*—My reason for more particularly naming Kepler in these remarks on the influence of direct sensuous contemplation has been to point out how, in this great and highly gifted man, a taste for imaginative combinations was combined with a remarkable talent for observation, an earnest and severe method of induction, a courageous and almost unparalleled perseverance in calculation, and a mathematical profoundness of mind, which, revealed in his "Stereometria Doliorum," exercised a happy influence on Fermat, and, through him, on the invention of the theory of the infinitesimal calculus. A man endowed with such a mind was preeminently qualified by the richness and mobility of his ideas, and by the bold cosmical conjectures which he advanced, to animate and augment the movement which led the seventeenth century uninterruptedly forward to the exalted object presented in an extended contemplation of the universe.—HUMBOLDT *Cosmos*, vol. ii, pt. ii, p. 327. (H., 1897.)

2813. QUALITIES, MORAL, REQUIRED IN SCIENTIFIC INVESTIGATOR—Science [early] fascinated me on its own account. To carry it duly and honestly out, moral qualities were incessantly invoked. There was no room allowed for insincerity—no room even for carelessness. The edifice of science had been raised by men who had unswervingly followed the truth as it is in Nature, and in doing so had often sacrificed interests which are usually potent in this world.—TYNDALL *Fragments of Science*, vol. ii, ch. 15, p. 383. (A., 1900.)

2814. QUESTIONS FOR WHICH SCIENCE HAS NO ANSWER—*Yearning a Prophecy.*—[The] notion of decay, however, implied a reference to a period, when the Matterhorn was in the full strength of mountainhood. My thoughts naturally ran back to its possible growth and origin. Nor did they halt there, but wandered on through molten worlds to that nebulous haze which philosophers have regarded, and with good reason, as the proximate source of all material things. . . . Did that formless fog contain potentially the sadness with which I regarded the Matterhorn? Did the thought which now ran back to it simply return to its primeval home? . . .

Questions like these, useless as they seem, may still have a practical outcome. For if the final goal of man has not been yet attained, if his development has not been yet arrested, who can say that such yearnings and questions are not necessary to the opening of a finer vision, to the budding and the growth of diviner powers? Without this upward force could man have risen to his present height? When I look at the heavens and the earth, at my own body, at my strength and weakness of mind, even at these ponderings, and ask myself, Is there no being or thing in the universe that knows more about these matters than I do? what is my answer?—TYNDALL *Hours of Exercise in the Alps*, ch. 24, p. 291. (A., 1898.)

2815. RACE DEPENDENT UPON SINGLE TREE—*The South-American Fan-palm.*—The *Mauritia* [fan-palm] not only affords a secure habitation, but likewise yields numerous articles of food. Before the tender spathe unfolds its blossoms on the male palm, and only at that peculiar period of vegetable metamorphosis, the medullary portion of the trunk is found to contain a sago-like meal, which, like that of the *Jatropha* root, is dried in thin bread-like slices. The sap of the tree when fermented constitutes the sweet inebriating palm-wine of the Guaranes. The narrow-scaled fruit, which resembles reddish pine-cones, yields, like the banana and almost all tropical fruits, different articles of food, according to the periods at which it is gathered, whether its saccharine properties are fully matured, or whether it is still in a farinaceous condition. Thus in the lowest grades of man's development we find the existence of an entire race dependent upon almost a single tree; like certain insects which are confined to particular portions of a flower.—HUMBOLDT *Views of Nature*, p. 13. (Bell, 1896.)

2816. RACE, IMPROVEMENT OF, BY INDIVIDUAL SELF-DISCIPLINE—Every course of intellectual and moral self-discipline, steadily and honestly pursued, tends not merely to clear the mental vision of the individual, but to ennoble the race; by helping to develop that intuitive power which arises in the first instance from the embodiment in the human constitution of the general resultants of antecedent experience, but which, in its highest form, far transcends the experience that has furnished the materials for its evolution—just as the creative power of imagination shapes out conceptions which no merely constructive skill could devise.—CARPENTER *Mental Physiology*, bk. ii, ch. 11, p. 485. (A., 1900.)

2817. RACE SLOWLY OUTGROWS CHILDISH CONCEPTION—*Stars Set in Crystal Sphere.*—It must be admitted that the idea of the stars being set in a hollow sphere of crystal, forming the vault of the

firmament, was a very natural one. They seemed to revolve around the earth every day for generation after generation without the slightest change in their relative positions. If there were no solid connection between them, it does not seem possible that a thousand bodies could move around their vast circuit for such long periods of time without a single one of them varying its distance from one of the others. It is especially difficult to conceive how they could all move around the same axis. But when they are all set in a solid sphere, every one is made secure in its place. The planets could not be set in the same sphere, because they change their positions among the stars. This idea of the sphericity of the heavens held on to the minds of men with remarkable tenacity. The fundamental proposition of the system, both of Ptolemy and Copernicus, was that the universe is spherical, the latter seeking to prove the naturalness of the spherical form by the analogy of a drop of water, altho the theory served him no purpose whatever. Faint traces of the idea are seen here and there in Kepler, with whom it vanished from the mind of the race, as the image of Santa Claus disappears from the mind of the growing child.—NEWCOMB *Popular Astronomy*, pt. i, int., p. 4. (A. B. Co.)

2818. RADIATION FROM LEAVES—*Space Draining Plants of Heat—Death of Leaves that Cannot Turn.*—We doubted at first whether radiation would affect in any important manner objects so thin as are many cotyledons and leaves, and more especially affect differently their upper and lower surfaces; for altho the temperature of their upper surfaces would undoubtedly fall when freely exposed to a clear sky, yet we thought that they would so quickly acquire by conduction the temperature of the surrounding air, that it could hardly make any sensible difference to them whether they stood horizontally and radiated into the open sky, or vertically and radiated chiefly in a lateral direction towards neighboring plants and other objects. We endeavored, therefore, to ascertain something on this head by preventing the leaves of several plants from going to sleep, and by exposing to a clear sky when the temperature was beneath the freezing-point, these, as well as the other leaves on the same plants which had already assumed their nocturnal vertical position. Our experiments show that leaves thus compelled to remain horizontal at night suffered much more injury from frost than those which were allowed to assume their normal vertical position.—DARWIN *Power of Movement in Plants*, ch. 6, p. 285. (A., 1900.)

2819. RADIATION FROM METAL AND WOOL—*Protecting Cover Should Fit Loosely.*—Here are two metal vessels, one of which is covered with lampblack, while the other is bright. Three-quarters of an hour ago boiling water was poured into them, a thermometer being placed in each. Both thermometers then showed the same temperature, but now one of them is some degrees below the other, the vessel which has cooled most rapidly being the coated one. Here, again, are two vessels, one of which is bright, and the other closely coated with flannel. Half an hour ago two thermometers, plunged in these vessels, showed the same temperature, but the covered vessel has now a temperature two or three degrees lower than the naked one. It is not unusual to preserve the heat of teapots by a woolen covering; but to be effective the "cozy" must fit very loosely. A closely fitting cover which has the heat of the teapot freely imparted to it by contact would, as we have seen, promote the loss which it is intended to diminish, and thus do more harm than good.—TYNDALL *Heat a Mode of Motion*, lect. 11, p. 299. (A., 1900.)

2820. RADIATION KEEPING PACE WITH CONTRACTION — *Would Sustain Sun's Heat for Millions of Years.*—Calculation shows that, assuming the thermal capacity of the sun to be the same as that of water, the temperature might be raised to 28,000,000 of degrees, if this quantity of heat could ever have been present in the sun at one time. This cannot be assumed, for such an increase of temperature would offer the greatest hindrance to condensation. It is probable rather that a great part of this heat, which was produced by condensation, began to radiate into space before this condensation was complete. But the heat which the sun could have previously developed by its condensation would have been sufficient to cover its present expenditure for not less than 22,000,000 of years of the past.—HELMHOLTZ *Popular Lectures*, lect. 4, p. 181. (L. G. & Co., 1898.)

2821. RAIN, SILENT ACTION OF—*Solid Rocks Dissolved—"The Waters Wear the Stones" (Job xiv. 19).*—The most conspicuous agent employed [in the disintegration of rocks] is rain. Rain is not chemically pure, but always contains some proportion of oxygen and carbonic acid absorbed from the atmosphere; and after it reaches the ground organic acids are derived by it from the decaying vegetable and animal matter with which soils are more or less impregnated. Armed with such chemical agents, it attacks the various minerals of which rocks are composed, and thus, sooner or later, these minerals break up. . . . In all regions where rain falls the result of this chemical action is conspicuous; soluble rocks are everywhere dissolving, while partially soluble rocks are becoming rotten and disintegrated. In limestone areas it can be shown that sometimes hundreds of feet of rock have thus been gradually and silently removed from the surface of the land. And the great depth now and

again attained by rotted rock testifies likewise to the destructive action of rain-water percolating from the surface.—GEIKIE *Earth Sculpture*, ch. 2, p. 25. (G. P. P., 1898.)

2822. RAINBOW, NO PERFECT IMAGE OF IN WATER—Seeing two [rainbows], the one in the heavens, the other in the water, you might be disposed to infer that the one bears the same relation to the other that a tree upon the water's edge bears to its reflected image. The rays, however, which reach an observer's eye after reflection, and which form a bow, would, were their course uninterrupted, converge to a point vertically under the observer, and as far below the level of the water as his eye is above it. But under no circumstances could an eye above the water-level, and one below it, see the same bow—in other words, the selfsame drops of rain cannot form the reflected bow and the bow seem directly in the heavens. The reflected bow, therefore, is not, in the usual optical sense of the term, the image of the bow seen in the sky. —TYNDALL *Lectures on Light*, lect. 1, p. 26. (A., 1898.)

2823. RANGE OF THE CONDOR—*A Run Necessary for Flight—A Palisade Trap.*—This bird [the condor], which, singularly enough, like the lamas, vicuñas, alpacas, and guanacos, is not found beyond the equator in New Granada, penetrates as far south as the Straits of Magellan. In Chile, as in the elevated plateaux of Quito, the condors, which usually live in pairs, or even alone, congregate in flocks for the purpose of attacking lambs and calves, or seizing on young guanacos (guanacillos). The havoc annually committed by the condor among the herds of sheep, goats, and cattle, as well as among the wild vicuñas, alpacas, and guanacos of the chain of the Andes, is very considerable. The Chileans assert that this bird when in captivity can endure hunger for forty days; when in a free state, however, its voracity is excessive, and it then, like the vulture, feeds by preference on carrion.

The mode of catching these birds, by an enclosure of palisades. . . . is as successful in Chile as in Peru; for the bird, after being rendered heavy from excess of food, is obliged to run a short distance with half-extended wings before it can take flight. A dead ox, which is already in an incipient state of decomposition, is strongly enclosed with palisades, within which narrow space the condors throng together; being unable, as already observed, to fly on account of the excess of food which they have devoured, and impeded in their run by the palisades, these birds are either killed by the natives with clubs, or are caught alive by the lasso. The condor was represented as a symbol of strength on the coinage of Chile immediately after the first declaration of political independence.—HUMBOLDT *Views of Nature*, p. 239. (Bell, 1896.)

2824. RAYS OF STARS—*Splendor of the Heavens Increased by Optical Illusion.*—The rays of the stars disappear when the image of the radiating star is seen through a very small aperture made with a needle in a card, and I have myself frequently observed both Canopus and Sirius in this manner. The same thing occurs in telescopic vision through powerful instruments, when the stars appear either as intensely luminous points, or as exceedingly small disks. Altho the fainter scintillation of the fixed stars in the tropics conveys a certain impression of repose, a total absence of stellar radiation would, in my opinion, impart a desolate aspect to the firmament, as seen by the naked eye. Illusion of the senses, optical illusion, and indistinct vision, probably tend to augment the splendor of the luminous canopy of heaven.—HUMBOLDT *Cosmos*, vol. iii, p. 128. (H., 1898.)

2825. REACTION OF ENVIRONMENT ON MAN—*Physical Influences Have Mental Results.*—The knowledge of the character of Nature in different regions is most intimately associated with the history of the human race and its mental culture. For altho the dawn of this culture cannot have been determined solely by physical influence, climatic relations have at any rate to a great extent influenced its direction, as well as the character of nations, and the degree of gloom or cheerfulness in the dispositions of men. How powerfully did the skies of Greece act on its inhabitants! Was it not among the nations who settled in the beautiful and happy region between the Euphrates, the Halys, and the Ægean Sea that social polish and gentler feelings were first awakened? and was it not from these genial climes that our forefathers, when religious enthusiasm had suddenly opened to them the Holy Lands of the East, brought back to Europe, then relapsing into barbarism, the seeds of a gentler civilization? The poetical works of the Greeks and the ruder songs of the primitive northern races owe much of their peculiar character to the forms of plants and animals, to the mountain-valleys in which their poets dwelt, and to the air which surrounded them. To revert to more familiar objects, who is there that does not feel himself differently affected beneath the embowering shade of the beechen grove, or on hills crowned with a few scattered pines, or in the flowering meadow where the breeze murmurs through the trembling foliage of the birch? A feeling of melancholy, or solemnity, or of light, buoyant animation is in turn awakened by the contemplation of our native trees. This influence of the physical on the moral world—this mysterious reaction of the sensuous on the ideal—gives to the study of Nature, when considered from a higher point of view, a peculiar charm which has not hitherto been sufficiently recognized.—HUMBOLDT *Views of Nature*, p. 219. (Bell, 1896.)

2826. READINESS OF NERVE-CURRENTS TO FOLLOW ACCUSTOMED PATHS—*Paths Deepened as Traversed—The Power of Habit.*—Of course, a simple habit, like every other nervous event—the habit of snuffling, for example, or of putting one's hands into one's pockets, or of biting one's nails—is, mechanically, nothing but a reflex discharge, and its anatomical substratum must be a path in the system. The most complex habits . . . are, from the same point of view, nothing but concatenated discharges in the nerve-centers, due to the presence there of systems of reflex paths, so organized as to wake each other up successively, the impression produced by one muscular contraction serving as a stimulus to provoke the next, until a final impression inhibits the process and closes the chain. . . . For the entire nervous system is nothing but a system of paths between a sensory *terminus a quo* and a muscular, glandular, or other *terminus ad quem.* A path once traversed by a nerve-current might be expected to follow the law of most of the paths we know, and to be scooped out and made more permeable than before; and this ought to be repeated with each new passage of the current. . . . So nothing is easier than to imagine how, when a current once has traversed a path, it should traverse it more readily still a second time.—JAMES *Psychology,* vol. i, ch. 4, p. 107. (H. H. & Co., 1899.)

2827. READING OF CHARACTER A RARE ATTAINMENT—*Its Perfection Involves Knowledge Not Less Than Omniscient (John ii, 24).*—Even overlooking human reticence, and, what is worse, human hypocrisy, the conditions of an accurate reading of others' minds are rarely realized. If, as has been remarked by a good authority, one rarely meets, even among intelligent people, with a fairly accurate observer of external things, what shall be said as to the commonly claimed power of "intuitive insight" into other people's thoughts and feelings, as tho it were a process above suspicion? It is plain, indeed, on a little reflection, that, taking into account what is required in the way of large and varied experience (personal and social), a habit of careful introspection, as well as a habit of subtle discriminative attention to the external signs of mental life, and lastly a freedom from prepossession and bias, only a very few can ever hope even to approximate to good readers of character.—SULLY *Illusions,* ch. 9, p. 229. (A., 1897.)

2828. REALITY OF THE HUMAN SOUL—*No Ghostly Universe—Thoughts and Feelings the Surest of All Facts.*—What we call the soul, the mind, the conscious self, is something strange and wonderful. In our ordinary efforts to conceive it, invisible and impalpable as it is, we are apt to try so strenuously to divorce it from the notion of substance that it seems ethereal, unreal, ghostlike. Yet of all realities the soul is the most solid, sound, and undeniable. Thoughts and feelings are the fundamental facts from which there is no escaping. Our whole universe, from the sands on the seashore to the flaming suns that throng the Milky Way, is built up of sights and sounds, of tastes and odors, of pleasures and pains, of sensations of motion and resistance either felt directly or inferred. This is no ghostly universe, but all intensely real as it exists in that intensest of realities, the human soul!—FISKE *Through Nature to God,* pt. ii, ch. 5, p. 27. (H. M. & Co., 1900.)

2829. REASON, THE INTENTIONAL ADAPTATION OF MEANS TO ENDS—Reason or intelligence is the faculty which is concerned in the intentional adaptation of means to ends. It therefore implies the conscious knowledge of the relation between means employed and ends attained, and may be exercised in adaptation to circumstances novel alike to the experience of the individual and to that of the species.—ROMANES *Animal Intelligence,* int., p. 17. (A., 1899.)

2830. REASON WORKING FOR EVIL—*Cruel Practises Logical Results from False Premises.*—It is astonishing how reasonable—that is to say, how logical—are even the most revolting practises connected, for example, with religious worship or religious customs, provided we accept as true some fundamental conception of which they are the natural result. If it be true that the God we worship is a being who delights in suffering, and takes pleasure, as it were, in the very smell of blood, then it is not irrational to appease him with hecatombs of human victims. This is an extreme case. There are, however, such cases, as we know, actually existing in the world. But, short of this, the same principle is illustrated in innumerable cases, where cruel and apparently irrational customs are in reality nothing but the logical consequences of some fundamental belief respecting the nature, the character, and the commands of God. In like manner, in the region of morals and of conduct not directly connected with religious beliefs, reason may be nothing but the servant of desire, and in this service may have no other work to do than that of devising means to the most wicked ends. If the doctrine given to reason be the doctrine that pleasure and self-indulgence, at whatever sacrifice to others, are the great aims and ends of life, then reason will be busy in seeking out "many inventions" for the attainment of them, each invention being more advanced than another in its defiance of all obligation and in its abandonment of all sense of duty. Thus the development of selfishness under the guidance of faculties which place at its command the great powers of foresight and contrivance, is a kind of development quite as natural and quite as common as that which constitutes the growth of knowledge and of virtue. It is, indeed, a development which, under the con-

dition supposed—that is to say, the condition of false or erroneous data supplied to the reasoning faculty—is not an accident or a contingency, but a necessary and inevitable result.—ARGYLL *Unity of Nature*, ch. 10, p. 260. (Burt.)

2831. REASONING, APPARENT INSTANCE OF, AMONG BEES—*Inference Sagaciously Drawn.*—Huber gives a case of apparent exercise of reason, or power of inference from a particular case to other and general cases. A piece of comb fell down and was fixed in its new position by wax. The bees then strengthened the attachments of all the other combs, clearly because they inferred that they, too, might be in danger of falling. This is a very remarkable case, and leads Huber to exclaim, "I admit that I was unable to avoid a feeling of astonishment in the presence of a fact from which the purest reason seemed to shine out."—ROMANES *Animal Intelligence*, ch. 4, p. 185. (A., 1899.)

2832. —— —— *Intelligence Shown in Repair of Damages.*—A closely similar and therefore corroborative case [cf. 2831] of an even more remarkable kind is thus narrated in Watson's "Reasoning Power of Animals," p. 448:

"Dr. Brown, in his book on the bee, gives another illustration of the reasoning power of bees, observed by a friend of his. A center comb in a hive, being overburdened with honey, had parted from its fastenings and was pressing against another comb, so as to prevent the passage of the bees between them. This accident excited great bustle in the colony, and as soon as their proceedings could be observed it was found that they had constructed two horizontal beams between the two combs, and had removed enough of the honey and wax above them to admit the passage of a bee, while the detached comb had been secured by another beam and fastened to the window with spare wax. But what was most remarkable was that, when the comb was thus fixed, they removed the horizontal beams first constructed as being of no further use. The whole occupation took about ten days."—ROMANES *Animal Intelligence*, ch. 4, p. 185. (A., 1899.)

2833. REASONING VS. EMPIRICAL JUDGMENT—*Cloth and Dyestuff.*—Suppose I say, when offered a piece of cloth, "I won't buy that; it looks as if it would fade," meaning merely that something about it suggests the idea of fading to my mind; my judgment, tho possibly correct, is not reasoned, but purely empirical; but if I can say that into the color there enters a certain dye which I know to be chemically unstable, and that therefore the color will fade, my judgment is reasoned. The notion of the dye, which is one of the parts of the cloth, is the connecting link between the latter and the notion of fading.—JAMES *Psychology*, vol. ii, ch. 22, p. 340. (H. H. & Co., 1899.)

2834. RECITATION, VERBAL, VALUE OF—*Reaction of Mind upon Impressions.*—The older pedagogic method of learning things by rote, and reciting them parrot-like in the schoolroom, rested on the truth that a thing merely read or heard, and never verbally reproduced, contracts the weakest possible adhesion in the mind. Verbal recitation or reproduction is thus a highly important kind of reactive behavior on our impressions; and it is to be feared that, in the reaction against the old parrot recitations as the beginning and end of instruction, the extreme value of verbal recitation as an element of complete training may nowadays be too much forgotten.—JAMES *Talks to Teachers*, ch. 5, p. 34. (H. H. & Co., 1900.)

2835. RECOGNITION, A TRIUMPH OF—*Uranus Often Seen Before—Herschel Recognized It as a Planet.*—So soon as astronomers had recognized the nature of the path of Uranus, so as to be able to predict the motions of the planet, they could also trace back its course, so as to find where it had been at any given time before its discovery. Now, when this had been done, it was found that Uranus had in reality been often observed before—no less than nineteen times, in fact.

It had been observed by the eminent astronomers Flamsteed, Bradley, Mayer, and Lemonnier. Flamsteed had seen it five times, each time recording its place as that of a star of the fifth magnitude. But Lemonnier had actually seen the planet no less than twelve times. Unfortunately, Lemonnier was not an orderly man; "his astronomical papers," says one who has recently written on the subject, "are said to have been a very picture of chaos"; and M. Bouvard narrates that he had "seen one of Lemonnier's observations of this very star written on a paper-bag which had contained hair-powder." So narrowly had the planet escaped recognition until its discovery should come to reward the most laborious of all astronomers—the great Sir W. Herschel.—PROCTOR *Expanse of Heaven*, p. 117. (L. G. & Co., 1897.)

2836. RECOGNITION, MARKS THAT SERVE FOR—*Varied Colors of Birds.*—If we consider the habits and life histories of those animals which are more or less gregarious, comprising a large proportion of the herbivora, some carnivora, and a considerable number of all orders of birds, we shall see that a means of ready recognition of its own kind, at a distance or during rapid motion, in the dusk of twilight or in partial cover, must be of the greatest advantage and often lead to the preservation of life.

Among birds, these recognition marks are especially numerous and suggestive. Species which inhabit open districts are usually pro-

tectively colored; but they generally possess some distinctive markings for the purpose of being easily recognized by their kind, both when at rest and during flight. Such are the white bands or patches on the breast or belly of many birds, but more especially the head and neck markings in the form of white or black caps, collars, eye-marks or frontal patches.—WALLACE *Darwinism*, ch. 8, pp. 147-150. (Hum.)

2837. RECOGNITION, MATERNAL—*Possible Only among the Higher Animals.*—The next thing [in the evolution of motherhood] was to make it possible for the parent to recognize its young. . . . In the lower reaches the young are never in the smallest degree like their parents, and, granting the highest power of recognition to the mother, it is impossible that she should recognize her own offspring. For generations even science was imposed upon here, for many forms of life were described and classified as distinct species which have turned out to be simply the young of other species. . . . The larval forms of the starfish, or the sea-urchin, or their kinsman the holothurian are disguised past all recognition; and among the insects the relation between butterflies and moths and their respective caterpillars is beyond any possible clue. No doubt there are other modes of recognition in Nature than those which depend on the sense of sight. But looked at on every side, the fact remains that the power to identify their young is all but absent until the higher animals appear.—DRUMMOND *Ascent of Man*, ch. 8, p. 274. (J. P., 1900.)

2838. RECOGNITION OF THE IDEAL —*The First Step toward Conformity.*—The recognition of the ideal is the first step in the direction of conformity. But let it be clearly observed that it is but a step. There is no vital connection between merely seeing the ideal and being conformed to it.—DRUMMOND *Natural Law in the Spiritual World*, essay 8, p. 274. (H. Al.)

2839. RECOGNITION OF UNSEEN POWER—*Illustration of Mill Shaft.*—If we think the man foolish who supposes the main shaft of a cotton-mill to turn of itself, merely because he sees it apparently end in a wall which conceals from him the source of its motive power, are we not really chargeable with the like folly if we attribute self-motion to the ultimate molecules of matter, merely because the power that moves them is hid from our sight?—CARPENTER *Nature and Man*, lect. 12, p. 363. (A., 1889.)

2840. RECOIL OF CANNON—*Gun Heavy To Absorb Its Own Reaction.*—In constructing a cannon provision must always be made for its recoil when fired. A cannon that fires a very heavy shot must itself be heavy, for two reasons: first, in order that it may be strong enough to resist the charge of powder, and, secondly, that it may be heavy enough to absorb the reaction, so that the recoil will not be too great.—ELISHA GRAY *Nature's Miracles*, vol. ii, ch. 1, p. 8. (F. H. & H., 1900.)

2841. RECONCILIATION, IRRATIONAL—*Attempt to Force Science to Accord with Supposed Biblical Teaching—Scheme of Tycho Brahe.*—There was a slight delay in the adoption of the theory of the central sun and the motion of the earth, a delay due to the astronomer Tycho Brahe, who contrived, in 1582, a mixed system susceptible of reconciling observation with the Bible, in the name of which the teaching-schools refused to accept the theory of the earth's motion.

Here is how the Danish astronomer himself states his theory:

"I think it is decidedly necessary, without any doubt, to place the earth motionless at the center of the system, according to the opinion of the ancients and the testimony of Scripture. I do not admit, with Ptolemy, that the earth may be the center of the orbits of the second 'mobile,' but I think that the celestial motions are arranged so that the moon and the sun only, with the eighth sphere, the most distant of all, and which includes all the others, have the center of their motion near the earth. The five other planets revolve round the sun as round their chief and king, and the sun must be incessantly in the midst of their orbs, which accompany him in his annual motion. . . . Thus the sun would be the ruler and end of all these revolutions, and, like Apollo in the midst of the Muses, he would rule alone all the celestial harmony."

To the system of Tycho Brahe there exists the same serious objection which was made to that of Ptolemy, since in fixing the earth at the center of the world-system he supposed that the sun, all the planets, and the whole sky of fixed stars, described round us their immense orbits in twenty-four hours. It never enjoyed a real influence.—FLAMMARION *Popular Astronomy*, bk. iv, ch. 1, p. 343. (A.)

2842. RECONSTRUCTION FROM FRAGMENTS—*Intuitive Perception of Genius—Agassiz Rivals Exploit of Cuvier—Extinct Crustacean of Balruddery Restored.*—The numerous specimens . . . were spread out before us. . . . There were the fragments of scaly rhombs, of scaly crescents, of scaly circles, with scaly parallelograms attached to them, and of several other regular compound figures besides. . . . Agassiz glanced over the collection. One specimen especially caught his attention—an elegantly symmetrical one. It seemed a combination of the parallelogram and the crescent; there were pointed horns at each end; but the convex and concave lines of the opposite sides passed into almost parallel right lines towards the center. His eye brightened as he contemplated it. "I will tell you," he said, turning to the company—"I will tell you what these are—the remains

of a huge lobster." He arranged the specimens in the group before him with as much apparent ease as I have seen a young girl arranging the pieces of ivory or mother-of-pearl in an Indian puzzle. A few broken pieces completed the lozenge-shaped shield; two detached specimens, placed on its opposite sides, furnished the claws; two or three semirings, with serrated edges, composed the jointed body; the compound figure, which but a minute before had so strongly attracted his attention, furnished the terminal flap, and there lay the huge lobster before us, palpable to all. There is homage due to supereminent genius, which Nature spontaneously pays when there are no low feelings of envy or jealousy to interfere with her operations, and the reader may well believe that it was willingly rendered on this occasion to the genius of Agassiz.—MILLER *Old Red Sandstone*, ch. 8, p. 135. (G. & L., 1851.)

2843. RECORD, ENDURING, OF THE EVANESCENT—*Prints of Rain-drops in Geologic Rocks.*—It may be asked how any clue can be found to phenomena so evanescent as those of clouds and moisture. But do we not trace in the old deposits the rain-storms of past times? The heavy drops of a passing shower, the thick, crowded tread of a splashing rain, or the small pin-pricks of a close and fine one—all the story, in short, of the rising vapors, the gathering clouds, the storms and showers of ancient days, we find recorded for us in the fossil rain-drops; and when we add to this the possibility of analyzing the chemical elements which have been absorbed into the soil, but which once made part of the atmosphere, it is not too much to hope that we shall learn something hereafter of the meteorology even of the earliest geological ages.—AGASSIZ *Geological Sketches*, ser. i, ch. 3, p. 74. (H. M. & Co., 1896.)

2844. RECORD OF MEMORY IMPERISHABLE—*Accident May Recall What is Lost from Consciousness—The Day of Judgment.*—Accordingly, in a brain that is not disorganized by injury or disease, the organic registrations are never actually forgotten, but endure while life lasts; no wave of oblivion can efface their characters. Consciousness, it is true, may be impotent to recall them; but a fever, a blow on the head, a poison in the blood, a dream, the agony of drowning, the hour of death, rending the veil between our present consciousness and these inscriptions, will sometimes call vividly back, in a momentary flash, and call back, too, with all the feelings of the original experience, much that seemed to have vanished from the mind forever. In the deepest and most secret recesses of mind there is nothing hidden from the individual self, or from others, which may not be thus some time accidentally revealed, so that it might well be that, as De Quincey surmised, the opening of the book at the day of judgment shall be the unfolding of the everlasting scroll of memory.—MAUDSLEY *Body and Mind*, lect. 1, p. 26. (A., 1898.)

2845. RECORDS, EARLY, OF SCIENTIFIC FACT—*Eruptions of Etna.*—Etna appears to have been in activity from the earliest times of tradition, for Diodorus Siculus mentions an eruption which caused a district to be deserted by the Sicani before the Trojan war. Thucydides informs us that in the sixth year of the Peloponnesian war, or in the spring of the year 425 B. C., a lava-stream ravaged the environs of Catania, and this, he says, was the third eruption which had happened in Sicily since the colonization of that island by the Greeks. The second of the three eruptions alluded to by the historian took place in the year 475 B. C., and was that so poetically described by Pindar, two years afterwards, in his first Pythian ode. . . .

In these verses a graphic description is given of Etna, such as it appeared five centuries before the Christian era, and such as it has been seen when in eruption in modern times. The poet is only making a passing allusion to the Sicilian volcano as the mountain under which Typhœus lay buried, yet by a few touches of his master-hand every striking feature of the scene has been faithfully portrayed. We are told of "the snowy Etna, the pillar of heaven—the nurse of everlasting frost, in whose deep caverns lie concealed the fountains of unapproachable fire—a stream of eddying smoke by day, a bright and ruddy flame by night, and burning rocks rolled down with loud uproar into the sea."—LYELL *Principles of Geology*, bk. ii, ch. 25, p. 398. (A., 1854.)

2846. RECORDS, IMPERISHABLE, OF THE BABYLONIANS—*Humane Laws—Astronomical Beginnings—Cuneiform Inscriptions.*—Of the early Babylonians or Chaldeans less is known [than of the Egyptians], yet their monuments and inscriptions show how ancient and how high was their civilization. Their writing was in cuneiform or wedge-shaped characters, of which they seem to have been the inventors, and which their successors, the Assyrians, learnt from them. They were great builders of cities, and the bricks inscribed with their kings' names remain as records of their great temples, such, for instance, as that dedicated to the god of Ur, at the city known to Biblical history as Ur of the Chaldees. Written copies of their laws exist, so advanced as to have provisions as to the property of married women, the imprisonment of a father or mother for denying their son, the daily fine of a half-measure of corn levied on the master who killed or ill-used his slaves. Their astrology, which made the names of Chaldean and Baylonian famous ever since, led them to make those regular

observations of the heavenly bodies which gave rise to the science of astronomy. The nation which wrote its name thus largely in the book of civilization dates back into the same period of high antiquity as the Egyptian.—TYLOR *Anthropology*, ch. 1, p. 22. (A., 1899.)

2847. RECORDS OF ANCIENT DEAD —*Histories Self-written in the Rocks.*—Indeed, the fossil remains of all times tell us almost as much of the physical condition of the world at different epochs as they do of its animal and vegetable population. When Robinson Crusoe first caught sight of the footprint on the sand he saw in it more than the mere footprint, for it spoke to him of the presence of men on his desert island. We walk on the old geological shores, like Crusoe along his beach, and the footprints we find there tell us, too, more than we actually see in them. The crust of our earth is a great cemetery, where the rocks are tombstones on which the buried dead have written their own epitaphs. They tell us not only who they were, and when and where they lived, but much also of the circumstances under which they lived. We ascertain the prevalence of certain physical conditions at special epochs by the presence of animals and plants whose existence and maintenance required such a state of things, more than by any positive knowledge respecting it.—AGASSIZ *Geological Sketches*, ser. i, ch. 2, p. 30. (H. M. & Co., 1896.)

2848. RECORDS OF GEOLOGY—*Compared with Human Traditions.*—There is a rabbinical tradition that the sons of Tubalcain, taught by a prophet of the coming deluge, and unwilling that their father's arts should be lost in it to posterity, erected two obelisks of brass, on which they inscribed a record of his discoveries, and that thus the learning of the family survived the cataclysm. The flood subsided, and the obelisks, sculptured from pinnacle to base, were found fast fixed in the rock. Now, the twin pyramids of the Old Red Sandstone, with their party-colored bars and their thickly crowded inscriptions, belong to a period immensely more remote than that of the columns of the antediluvians, and they bear a more certain record.—MILLER *The Old Red Sandstone*, ch. 9, p. 172. (G. & L., 1851.)

2849. RED A PREVALENT COLOR IN FAUNA OF THE DEEP SEA—The fauna of the deep sea, . . . taken as a whole, is not characterized by the predominance of any one color. The shades of red occur rather more frequently than they do in the fauna of any other zone or region, but whether this is in any way connected with the fact that red is the complementary color to that of the phosphorescent light, in which many of these animals live, it is at present difficult to say; it is possible that when we have further information concerning the colors of the animals living in the deeper parts of the neritic zone another explanation may be forthcoming.—HICKSON *Fauna of the Deep Sea*, ch. 4, p. 66. (A., 1894.)

2850. REENFORCEMENT, MUTUAL —*Bacteria Gain Power by Association.*—The association of organisms . . . is . . . a fact that is rapidly becoming of the first importance in bacteriology. When species were first isolated in pure culture it was found that they behaved somewhat differently under differing circumstances. This modification in function has been attributed to differences of environment and physical conditions. Whilst it is true that such external conditions must have a marked effect upon such sensitive units of protoplasm as bacteria, it has recently been proved that one great reason why modification occurs in pure artificial cultures is that the species has been isolated from amongst its colleagues and doomed to a separate existence. One of the most abstruse problems in the immediate future of the science of bacteriology is to learn what intrinsic characters there are in species or individuals which act as a basis for the association of organisms for a specific purpose. Some bacteria appear to be unable to perform their regular function without the aid of others. An example of such association is well illustrated in the case of tetanus, for it has been shown that if the bacilli and spores of tetanus alone obtain entrance to a wound the disease may not follow the same course as when with the specific organism the lactic-acid bacillus or the common organisms of suppuration or putrefaction also gain entrance. There is here evidently something gained by association.—NEWMAN *Bacteria*, ch. 1, p. 31. (G. P. P., 1899.)

2851. REFLECTION AND JUDGMENT SHOWN BY A WASP—*Securing Facilities of Transportation.*—Th. Meenan (*Proceedings of the Acad. of Nat. Sci.*, Philadelphia, January 22, 1878) observed a case with *Vespa maculata*. He saw one of these wasps try in vain to raise from the ground a grasshopper it had killed. When all its efforts proved to be in vain it pulled its prey to a maple-tree, about thirty feet off, mounted it with its prize, and flew away from it. "This," adds the writer, "was more than instinct. It was reflection and judgment, and the judgment was proved to be correct." [It could carry the load when once raised into the air, tho it could not fly up with it.]—ROMANES *Animal Intelligence*, ch. 4, p. 197. (A., 1899.)

2852. REFLECTION AND REFRACTION—*The Two Unite to Make the Rainbow.* —A beam of solar light falling obliquely upon a rain-drop is refracted on entering the drop. It is in part reflected at the back of the drop, and on emerging it is again refracted. By these two refractions—at its entrance and at its emergence—the beam of

light is decomposed, quitting the drop resolved into colored constituents. The light thus reaches the eye of an observer facing the drop, and with his back to the sun.—TYNDALL *Lectures on Light*, lect. 1, p. 24. (A., 1898.)

2853. REFRACTION, DOUBLE, OF LIGHT—*Iceland Spar.*—Pour water and disulfid of carbon into two cups of the same depth; the cup that contains the more strongly refracting liquid will appear shallower than the other. Place a piece of Iceland spar over a dot of ink; two dots are seen, the one appearing nearer than the other to the eye. The nearest dot belongs to the most strongly refracted [the ordinary] ray, exactly as the nearest cup bottom belongs to the most highly refracting liquid. When you turn the spar round, the extraordinary image of the dot rotates round the ordinary one, which remains fixed.—TYNDALL *Lectures on Light*, lect. 3, p. 114. (A., 1898.)

2854. REFRACTION ENHANCES SENSE OF VASTNESS—*Steppes of South America.*—The distant aspect of the steppe is the more striking when the traveler emerges from dense forests, where his eye has been familiarized to a limited prospect and luxuriant natural scenery. I shall ever retain an indelible impression of the effect produced on my mind by the llanos, when, on our return from the Upper Orinoco, they first broke on our view from a distant mountain, opposite the mouth of the Rio Apure, near the Hato del Capuchino. The last rays of the setting sun illumined the steppe, which seemed to swell before us like some vast hemisphere, while the rising stars were refracted by the lower stratum of the atmosphere. When the plain has been excessively heated by the vertical rays of the sun, the evolution of the radiating heat, the ascent of currents of air, and the contact of atmospheric strata of unequal density continue throughout the night.—HUMBOLDT *Views of Nature*, p. 28. (Bell, 1896.)

2855. REFRACTION OF LIGHT—*Diminished Velocity in Denser Medium, as Glass or Water.*—According to the undulatory theory, the velocity of light in water and glass is less than in air. Consider, then, a small portion of a wave issuing from a point of light so distant that the portion may be regarded as practically plane. Moving vertically downwards, and impinging on an horizontal surface of glass or water, the wave would go through the medium without change of direction. But as the velocity in glass and water is less than the velocity in air, the wave would be retarded on passing into the denser medium. But suppose the wave, before reaching the glass, to be oblique to the surface, that end of the wave which first reaches the medium will be the first retarded by it, the other portions as they enter the glass being retarded in succession. It is easy to see that this retardation of the one end of the wave must cause it to swing round and change its front, so that when the wave has fully entered the glass its course is oblique to its original direction. According to the undulatory theory, light is thus refracted.—TYNDALL *Lectures on Light*, lect. 3, p. 109. (A., 1898.)

2856. REFRIGERATION BY EXPANSION—*Liquefaction of Oxygen, Nitrogen, Hydrogen, and Air.*—In 1877 M. Cailletet had liquefied nitric oxid and acetylene, and on the 2d of December he placed in the hands of M. Henri Saint-Claire Deville a note wherein, in cautious but distinct terms, he announced the liquefaction of oxygen. On the 16th of the same month he repeated his experiments. . . . His plan of operation involved the application of the principle of refrigeration by expansion. . . . By instruments of great strength and supreme accuracy of fit he was able to subject a volume of oxygen gas to a pressure of 300 atmospheres. He might have multiplied this pressure tenfold without liquefying the gas, but instead of augmenting the pressure he suddenly released the gas from the pressure imposed upon it. It forcibly expanded, and the cold of expansion caused the gas to precipitate itself as a cloud, which the eminent men who witnessed the experiment agreed in pronouncing liquid oxygen. He subsequently applied the same method with success to nitrogen, hydrogen, and air, all of which, through the combination of pressure with sudden release from pressure, were caused to precipitate themselves in clouds.—TYNDALL *Heat a Mode of Motion*, lect. 5, p. 145. (A., 1900.)

2857. REGELATION, FARADAY'S DISCOVERY OF—*Blocks of Ice Freeze Together under Hot Water.*—In a lecture given at the Royal Institution in June, 1850, and reported in the *Athenæum* and *Literary Gazette* for that year, Faraday showed that when two pieces of ice, at a temperature of 32° F., are placed in contact with each other they freeze together by the conversion of the film of moisture between them into ice. The case of a snowball is a familiar illustration of the principle. When the snow is below 32°, and therefore dry, it will not cohere, whereas when it is in a thawing condition it can be squeezed into a hard mass. During one of the hottest days of July, 1857, when the thermometer was upwards of 100° F. in the sun, and more than 80° in the shade, I observed a number of blocks of ice, which had been placed in a heap, frozen together at their places of contact, and I afterwards caused them to freeze together under water as hot as the hand could bear.—TYNDALL *Hours of Exercise in the Alps*, ch. 1, p. 354. (A., 1898.)

2858. RELATIVITY, LAW OF—*Different Estimates from Same Height.*—The varying judgments may perhaps be, to some extent, accounted for by that doctrine of relativity which plays so important a part in philosophy. This doctrine affirms that the impressions made upon us by any circumstance, or combination of circumstances, depend upon our previous state. Two travelers upon the same height, the one having ascended to it from the plain, the other having descended to it from a higher elevation, will be differently affected by the scene around them. To the one Nature is expanding, to the other it is contracting, and impressions which have two such different antecedent states are sure to differ. In our scientific judgments the law of relativity may also play an important part.—TYNDALL *Fragments of Science*, vol. ii, ch. 8, p. 123. (A., 1897.)

2859. RELICS OF A DISTANT LAND AND AGE—*Deposits of Glacial Epoch.*—On the steep slope leading from the valley of the Rhone into the Val d'Illiez, erratics [scattered boulders], formerly many hundreds, if not thousands, in number, are strewn among the vines and under the shadow of the Spanish chestnuts. They are mostly of crystalline rock, while the valley itself is wholly excavated in limestones and slates. They have been derived from various places higher up in the valley of the Rhone.—BONNEY *Ice-work, Present and Past*, pt. i, ch. 1, p. 17. (A., 1896.)

2860. RELICS OF ANCIENT PAST IN PRESENT CIVILIZATION—As the fragment of a speech or song, a waking or a sleeping vision, the dream of a vanished hand, a draft of water from a familiar spring, the almost perished fragrance of a pressed flower, call back the singer, the loved and lost, the loved and won, the home of childhood, or the parting hour, so in the same manner there linger in this crowning decade of the crowning century bits of ancient ingenuity which recall to a whole people the fragrance and beauty of its past.—MASON *The Birth of Invention (Address at Centenary of American Patent System, Washington, D. C., 1891: Proceedings of the Congress*, p. 406).

2861. RELICS OF BRUTES ARE BONES AND TEETH—*Relics of Man Are Chiefly His Works—Archeology Links Geology and History.*—Nor does there appear to be any reason why those methods of examination which have proved so successful in geology should not also be used to throw light on the history of man in prehistoric times. Archeology forms, in fact, the link between geology and history. It is true that in the case of other animals we can, from their bones and teeth, form a definite idea of their habits and mode of life, while in the present state of our knowledge the skeleton of a savage could not always be distinguished from that of a philosopher. But, on the other hand, while other animals leave only teeth and bones behind them, the men of past ages are to be studied principally by their works: houses for the living, tombs for the dead, fortifications for defense, temples for worship, implements for use, and ornaments for decoration.—AVEBURY *Prehistoric Times*, ch. 1, p. 2. (A., 1900.)

2862. RELICS OF PRIMEVAL MAN—*The Old Man of Cromagnon—Cave-dwellers.*—The beautiful work of Lartet and Christy has vividly portrayed to us the antiquities of the limestone plateau of the Dordogne—the ancient Aquitania—remains which recall to us a population of Horites, or cave-dwellers, of a time anterior to the dawn of history in France, living much like the modern hunter-tribes of America, and . . . possibly contemporary—in their early history, at least—with the mammoth and its extinct companions of the later post-Pliocene forests. . . . What manner of people were they? The answer is given to us by the skeletons found in the cave of Cromagnon. This cavern is a shelter or hollow under an overhanging ledge of limestone, and excavated originally by the action of the weather on a softer bed. It fronts the southwest and the little river Vezère; and, having originally been about eight feet high and nearly twenty deep, must have formed a cozy shelter from rain or cold or summer sun, and with a pleasant outlook from its front. . . . The "Old Man of Cromagnon" was of great stature, being nearly six feet high. More than this, his bones show that he was of the strongest and most athletic muscular development—a Samson in strength: and the bones of the limbs have the peculiar form which is characteristic of athletic men habituated to rough walking, climbing, and running; for this is, I believe, the real meaning of the enormous strength of the thigh-bone and the flattened condition of the leg in this and other old skeletons. It occurs to some extent, tho much less than in this old man, in American skeletons. His skull presents all the characters of advanced age, tho the teeth had been worn down to the sockets without being lost, which, again, is the character of some, tho not of all, aged Indian skulls. The skull proper, or brain-case, is very long—more so than in ordinary modern skulls—and this length is accompanied with a great breadth, so that the brain was of greater size than in average modern men, and the frontal region was largely and well developed. . In this respect this most ancient skull fails utterly to vindicate the expectations of those who would regard prehistoric men as approaching to the apes. It is at the opposite extreme. The face, however, presented very peculiar characters. It was extremely broad, with projecting cheekbones and heavy jaw, in this resembling the coarse types of the American face, and the eye-orbits were square and elongated later-

ally. The nose was large and prominent, and the jaws projected somewhat forward. This man, therefore, had, as to his features, some resemblance to the harsher type of American physiognomy, with overhanging brows, small and transverse eyes, high cheek-bones, and coarse mouth. . . . The woman presented similar characters of stature and cranial form modified by her sex. . . . The ornaments of Cromagnon were perforated shells from the Atlantic and pieces of ivory.—DAWSON *Facts and Fancies in Modern Science*, ch. 4, p. 152. (A. B. P. S.)

2863. RELIGION AND SCIENCE NOT AT VARIANCE—*Loyalty to Truth Aids Both.*—Fully satisfied that religion and science cannot in reality be at variance, I have striven in the present publication to follow out the rule laid down by the Bishop of London in his excellent lecture delivered last year at Edinburgh. The man of science," says Dr. Tait, ought to go on, " honestly, patiently, diffidently, observing and storing up his observations, and carrying his reasonings unflinchingly to their legitimate conclusions, convinced that it would be treason to the majesty at once of science and of religion if he sought to help either by swerving ever so little from the straight rule of truth."—AVEBURY *Prehistoric Times*, pref., p. 9. (A., 1900.)

2864. RELIGION IMPREGNABLE IN THE ESTIMATE OF SCIENCE—*Herbert Spencer.*—" How truly its central position is impregnable," Herbert Spencer has well discerned, " religion has never adequately realized. In the devoutest faith, as we habitually see it, there lies hidden an innermost core of skepticism, and it is this skepticism which causes that dread of inquiry displayed by religion when face to face with science." True indeed; religion has never realized how impregnable are many of its positions.—DRUMMOND *Natural Law in the Spiritual World*, int., p. 26. (H. Al.)

2865. RELIGION MEETS NATURAL WANT — *General Craving of Man.* —This world of ours has, on the whole, been an inclement region for the growth of natural truth; but it may be that the plant is all the hardier for the bendings and buffetings it has undergone. The torturing of a shrub, within certain limits, strengthens it. Through the struggles and passions of the brute, man reaches his estate; through savagery and barbarism his civilization; and through illusion and persecution, his knowledge of Nature, including that of his own frame. The bias towards natural truth must have been strong to have withstood and overcome the opposing forces. Feeling appeared in the world before knowledge, and thoughts, conceptions, and creeds, founded on emotion, had, before the dawn of science, taken root in man. Such thoughts, conceptions, and creeds must have met a deep and general want, otherwise their growth could not have been so luxuriant, nor their abiding power so strong.—TYNDALL *Fragments of Science*, vol. ii, ch. 15, p. 373. (A., 1900.)

2866. RELIGION, MINGLING OF, WITH SCIENCE UNDESIRABLE—*Nebular Hypothesis Unsustained.*—It has indeed always seemed to me a circumstance to be regretted that religious questions should have been in any way associated with the scientific difficulties involved in this particular question [the nebular hypothesis]. There is always this objection to such associations, that, in forming them, we are apt to associate scientific errors with religious teachings, and these truths seem to suffer when the scientific errors are exposed. Thus well-meaning men have again and again injured the cause they were most eager to serve, by calling in to its aid unsuitable allies. But altho I can see no religious reasons for casting discredit on the theory that processes have gone on and are going on upon an infinitely vast scale, resembling those which we see daily going on around us upon a finite scale, yet it does appear to me that there are many excellent scientific reasons for doubting very gravely whether all the suns which people space were originally formed from masses of glowing gas.—PROCTOR *Our Place among Infinities*, p. 230. (L. G. & Co., 1897.)

2867. RELIGION MORE THAN SENSE OF DEPENDENCE—*Definition Includes the Thing To Be Defined.*—The definitions of religion have been even worse than the definitions of morality. Just as the attempt is made to account for morals apart from the sense of duty or of obligation in conduct, so is the attempt made to account for religion apart from the sense of mind or will in Nature. The great effort seems to have been to try how the essential idea of religion could be either most completely eliminated or else most effectually concealed. For example, a feeling of absolute dependence has been specified by Schleiermacher as the essence of religion. Yet it is evident that a sense of absolute dependence may be urgent and oppressive without the slightest tincture of religious feeling. A man carried off in a flood and clinging to a log of wood may have, and must have, a painful sense of absolute dependence on the log. But no one would think of describing this sense as a feeling of religion. . . . Any plausibility, therefore, which may attach to the proposition which identifies religion with the mere sense of dependence is due entirely to the fact that when men speak of a sense of dependence they suggest the idea of a particular kind of dependence—namely, dependence upon a being or a personality, and not dependence upon a thing. That is to say, that the plausibility of the definition is entirely due to an element of thought which it is specially framed to keep out of sight.—ARGYLL *Unity of Nature*, ch. 11, p. 267. (Burt.)

2868. RELIGION, ORIGIN AND MANIFESTATION OF—*Danger Awakens Religious Instinct.*—As long as no real danger threatens, we may laugh at the religious instinct, because it has no opportunity to act. But as soon as danger approaches it acts even in unbelievers.—DAHL *Die Nothwendigkeit der Religion eine letzte Consequenz der Darwinschen Lehre.* (Translated for *Scientific Side-Lights.)*

2869. RELIGION, PRIMEVAL, UNFOUNDED SPECULATION CONCERNING—*The One Element Common to All Religions—Worship of Superhuman Personality.*—Primeval man has kept no journal of his own first religious emotions, any more than of his own first appearance in the world. We are therefore thrown back upon pure speculation—speculation, indeed, which may find in the present, and in a comparatively recent past, some data for arriving at conclusions, more or less probable, on the conditions of a time which is out of sight. But among the very first of these data—if it be not, indeed, the one datum without which all others are useless—is a clear conception of the element which is common to all religions as they exist now, or as they can be traced back beyond the dawn of history into the dim twilight of tradition. Of this universal element in all religions "the Infinite" is no definition at all. It is itself much more vague and indefinite in meaning than the word which it professes to explain. And this is all the more needless, seeing that the common element in all religions, such as we know them now, is one of the greatest simplicity. It is the element of a belief in superhuman beings—in living agencies other and higher than our own.—ARGYLL *Unity of Nature*, ch. 11, p. 274. (Burt.)

2870. RELIGION, SCIENCE A HELPER OF—*Extension of Knowledge Leads to Higher Faith.*—In proportion as religion avails herself of the help of science and its labors to strengthen her position and power, so will she most typically and admirably fulfil her great office in ruling wisely and well the inner and higher life of man. As science progresses, so let religion advance with her; for the world, we shall find, is daily awakening to new beliefs, to the fuller knowledge of itself. The great, irresistible tide of human knowledge is sweeping away the old landmarks and resting-places with rapid force. And wise indeed are they who, recognizing the extension of knowledge as from God, betake themselves with the tide to higher levels of thought, and there construct their dwelling-places anew.—ANDREW WILSON *Science-Culture for the Masses*, p. 35. (Hum., 1888.)

2871. RELIGION, UNIVERSALITY OF—The universality of religion, its existence among all known peoples, may be regarded as indubitable evidence that its appearance is owing to necessary causes.—DAHL *Die Nothwendigkeit der Religion eine letzte Consequenz der Darwinschen Lehre.* (Translated for *Scientific Side-Lights.)*

2872. ——— ——— *No Adequate Evidence of Tribes without Religion.*—On one main point which has been questioned respecting existing facts the progress of inquiry seems to have established beyond any reasonable doubt that no race of men now exists so savage and degraded as to be, or to have been when discovered, wholly destitute of any conceptions of a religious nature. It is now [1883] well understood that all the cases in which the existence of such savages has been reported are cases which break down upon more intimate knowledge and more scientific inquiry.

Such is the conclusion arrived at by a careful modern inquirer, Professor Tiele, who says: "The statement that there are nations or tribes which possess no religion rests either on inaccurate observations or on a confusion of ideas. No tribe or nation has yet been met with destitute of belief in any higher beings, and travelers who asserted their existence have been afterwards refuted by facts. It is legitimate, therefore, to call religion, in its most general sense, an universal phenomenon of humanity."—ARGYLL *Unity of Nature*, ch. 11, p. 281. (Burt.)

2873. RENEWAL AFTER EXHAUSTION—*Impediments to New Action Removed—Sundew Leaf Dried to Clear It of Remains—Reanointing for Capture of Prey.*—As soon as tentacles which have remained closely inflected during several days over an object begin to reexpand, their glands secrete less freely, or cease to secrete, and are left dry. In this state they are covered with a film of whitish, semifibrous matter, which was held in solution by the secretion. The drying of the glands during the act of reexpansion is of some little service to the plant; for I have often observed that objects adhering to the leaves could then be blown away by a breath of air, the leaves being thus left unencumbered and free for future action. Nevertheless, it often happens that all the glands do not become completely dry; and in this case delicate objects, such as fragile insects, are sometimes torn by the reexpansion of the tentacles into fragments, which remain scattered all over the leaf. After the reexpansion is complete the glands quickly begin to resecrete, and as soon as full-sized drops are formed the tentacles are ready to clasp a new object.—DARWIN *Insectivorous Plants*, ch. 1, p. 13. (A., 1900.)

2874. REPAIR COMPENSATES WASTE—*Sleep Nature's Opportunity of Restoration.*—Repair is everywhere and always making up for waste. Tho the two processes vary in their relative rates, both are constantly going on. Tho during the active, waking state of an animal waste is in excess

of repair, yet repair is in progress; and tho during sleep repair is in excess of waste, yet some waste is necessitated by the carrying-on of certain never-ceasing functions. The organs of these never-ceasing functions furnish, indeed, the most conclusive proofs of the simultaneity of repair and waste. Day and night the heart never stops beating, but only varies in the rapidity and vigor of its beats, and hence the loss of substance which its contractions from moment to moment entail must from moment to moment be made good. Day and night the lungs dilate and collapse, and the muscles which make them do this must therefore be kept in a state of integrity by a repair which keeps pace with waste, or which alternately falls behind and gets in advance of it to a very slight extent.—SPENCER *Biology*, pt. ii, ch. 4, p. 216. (A., 1900.)

2875. REPOSE IS DEATH—*Knowledge and Progress from Action.*—Some years ago I found myself in discussion with a friend who entertained the notion that the general tendency of things in this world is towards equilibrium, the result of which would be peace and blessedness to the human race. My notion was that equilibrium meant not peace and blessedness, but death. No motive power is to be got from heat, save during its fall from a higher to a lower temperature, as no power is to be got from water save during its descent from a higher to a lower level. Thus also life consists, not in equilibrium, but in the passage towards equilibrium. . . . In times of strife and commotion we may long for peace, but knowledge and progress are the fruits of action.—TYNDALL *New Fragments*, p. 10. (A., 1897.)

2876. REPOSE SUCCEEDING STRESS AND STRAIN—*Quiet Hills the Remains of Once Vast Volcanoes—The British Isles Volcanic.*—In Devonian or Old Red Sandstone times, volcanic activity was renewed with fresh violence upon that part of the earth's surface now occupied by the British Islands. Along the line which now forms the Grampians there rose a series of volcanoes of the very grandest dimensions. Ben Nevis, and many others among the higher Scotch mountains, have been carved by denudation from the hard masses of granite, quartz-felsite, and other Plutonic rocks which formed the central cores of these ancient volcanic piles. The remains of the great lava-sheets and of the masses of volcanic agglomerate ejected from these grand Devonian volcanoes make up hill ranges of no mean altitude.—JUDD *Volcanoes*, ch. 10, p. 274. (A., 1899.)

2877. REPOSE SUGGESTED BY ASPECT OF STARS—*Vast and Swift Motion the Contrasted Fact.*—The motions taking place within the star-system are also altogether amazing when rightly apprehended. Contemplating the stars on a still night, the idea of infinite repose is suggested by their serenity of aspect. Judging the stars again by the ordinary tests of motion, the astronomers of old had abundant reason to regard them as the very emblems of fixity. But in the light of modern astronomical research, we have this lesson forced upon us, that every one of these bright orbs, and all the millions that are unseen save by telescopically strengthened vision, are urging their way so swiftly through space that the most rapid motions familiar to us must be regarded as absolute rest by comparison. We know with what startling rapidity an express train rushes past a quiet country station. In its swift motion and heavy mass it seems the embodiment of might and energy. Yet the swiftest express train moves but at the rate of about one mile in a minute of time, and its bulk is utterly insignificant compared with that of the smallest member of the solar system. What inconceivable energy must we recognize, then, in the motion of our sun through space, at a rate of hundreds of miles per minute, the whole of his attendant family (each member of which is traveling rapidly around him) accompanying him in his swift rush through the interstellar depths! Yet even this wonderful energy of motion seems little when compared with the flight of Sirius, an orb a thousand times larger than the sun, and traveling many times more swiftly. And we have abundant reasons for believing that amongst the stars revealed by powerful telescopes there are thousands as large as Sirius, and millions as large as our sun—all with their attendant systems speeding with inconceivable rapidity on their several courses!—PROCTOR *Our Place among Infinities*, p. 232. (L. G. & Co., 1897.)

2878. REPRODUCTION OF BACTERIA—*Almost Incredible Fertility—Checks upon Their Increase.*—Their minute size would make them harmless enough if it were not for an extraordinary power of multiplication. This power of growth and division is almost incredible. Some of the species which have been carefully watched under the microscope have been found under favorable conditions to grow so rapidly as to divide every half-hour or even less. The number of offspring that would result in the course of twenty-four hours at this rate is of course easily computed. In one day each bacterium would produce over 16,500,000 descendants, and in two days about 281,500,000,000. It has been further calculated that these 281,500,000,000 would form about a solid pint of bacteria and weigh about a pound. At the end of the third day the total descendants would amount to 47,000,000,000,000, and would weigh about 16,000,000 pounds. Of course these numbers have no significance, for they are never actual or even possible numbers. Long before the offspring reach even into the millions their rate of multiplication is

checked either by lack of food or by the accumulation of their own excreted products, which are injurious to them. But the figures do have interest, since they show faintly what an unlimited power of multiplication these organisms have, and thus show us that in dealing with bacteria we are dealing with forces of almost infinite extent.—CONN *Story of Germ Life*, ch. 1, p. 21. (A., 1900.)

2879. ——— ——— *Growth of Yeast —The Budding of a Plant (Matt. xiii, 33).*—Budding, division, and spore-formation are the three chief ways in which [bacteria] reproduce their kind. Budding occurs in some kinds of yeast. . . . The capsule of a large or mother-cell shows a slight protrusion outwards, which is gradually enlarged into a daughter-yeast and later on becomes constricted at the neck. Eventually it separates as an individual. The protoplasm of spores of yeast differs, as Hansen has pointed out, according to their conditions of culture.—NEWMAN *Bacteria*, ch. 1, p. 16. (G. P. P., 1899.)

2880. RESERVE OF POWER—*Physical Endurance without Food.*—On the eastern end of the ridge [of the Matterhorn] we halted to take a little food; not that I seemed to need it—it was the remonstrance of reason rather than the consciousness of physical want that caused me to do so.

Facts of this kind illustrate the amount of force locked up in the muscles which may be drawn upon without renewal. I had quitted London ill, and when the Matterhorn was attacked I was by no means well. In fact, this climb was one of the means adopted to drive the London virus from my blood. The day previous I had taken scarcely any food; and on starting from the cabin half a cup of bad tea, without any solid whatever, constituted my breakfast. Still, during the five hours' climb from the cabin to the top of the Matterhorn, tho much below par physically and mentally, I felt neither faint nor hungry. This is an old experience of mine upon the mountains. The Weisshorn, for example, was climbed on six meat lozenges, tho it was a day of nineteen hours. Possibly this power of long-continued physical effort, without eating, may be a result of bad digestion which deals out stingily, and therefore economically, to the muscles the energy of the food previously consumed.—TYNDALL *New Fragments*, p. 491. (A., 1897.)

2881. ——— ——— *The Sun's Energy Stored in Wood or Coal Operative after Any Lapse of Years.*—The sun [has] locked up in each tree a store of energy thousands of times greater than that which was spent in merely lifting the trunk from the ground, as we may see by unlocking it again when we burn the tree under the boiler of an engine; for it will develop a power equal to the lifting of thousands of its kind, if we choose to employ it in this way. This is so true that the tree may fall and turn to coal in the soil, and still keep this energy imprisoned in it—keep it for millions of years till the black lump under the furnace gives out, in the whirling spindles of the factory or the turning-wheel of the steamboat, the energy gathered in the sunshine of the primeval world.—LANGLEY *New Astronomy*, ch. 3, p. 73. (H. M. & Co.)

2882. RESISTANCE TO INFECTION —*Some Persons Insusceptible.*—There is ample evidence in support of the fact that not all the persons partaking of infected food suffer equally, and occasionally some escape altogether. We know little or nothing of the causes of such modification in the effect produced. It may be due to other organisms, or chemical substances already in the alimentary canal of the individual, or it may be due to some insusceptibility or resistance of the tissues. Be that as it may, it is a matter which must not be neglected in estimating the effects of food contaminated with bacteria or their products.—NEWMAN *Bacteria*, ch. 6, p. 180. (G. P. P., 1899.)

2883. RESOLVES STRENGTHENED BY ACTION—*Motor Effects in Brain Endure —Practical Opportunity the Fulcrum of Moral Power.*—Seize the very first possible opportunity to act on every resolution you make, and on every emotional prompting you may experience in the direction of the habits you aspire to gain. It is not in the moment of their forming, but in the moment of their producing motor effects, that resolves and aspirations communicate the new "set" to the brain. As the author last quoted [Bahnsen] remarks:

"The actual presence of the practical opportunity alone furnishes the fulcrum upon which the lever can rest, by means of which the moral will may multiply its strength and raise itself aloft. He who has no solid ground to press against will never get beyond the stage of empty gesture-making."—JAMES *Psychology*, vol. i, ch. 4, p. 124. (H. H. & Co., 1899.)

2884. RESPIRATION IN RAREFIED AIR—*Man at Great Heights—Wonderful Power of Condor.*—Ulloa, more than a hundred years ago, expressed his astonishment that the vulture of the Andes could soar at heights where the pressure of the atmosphere was less than fifteen inches. An opinion was at that time entertained, from the analogy of experiments made with the air-pump, that no animal could exist under this slight amount of atmospheric pressure. I have myself . . . seen the barometer fall to 14.85 inches on the Chimborazo; and my friend, M. Gay-Lussac, breathed for a quarter of an hour an atmosphere in which the pressure was only 12.9 inches. It must be admitted that man, when wearied by muscular exertion, finds himself in a state

of painful exhaustion at such elevations; but in the condor the respiratory process seems to be performed with equal facility under a pressure of 30 or of 13 inches. This bird probably raises itself voluntarily to a greater height from the surface of our earth than any other living creature. I use the expression "voluntarily," since small insects and silicious-shelled infusoria are frequently borne to greater elevations by a rising current of air. It is probable that the condor flies even higher than the above calculations would appear to show.—HUMBOLDT *Views of Nature*, p. 238. (Bell, 1896.)

2885. RESPIRATION IS COMBUSTION—*Food Supplies Fuel—Three Classes of Food Necessary.*—Respiration is a true example of combustion. The seat of the combustion is the lungs. The substance burnt is sugar. The products are carbonic dioxid gas and water. The materials of animal food may be divided into three classes: non-nitrogenized substances, such as starch and sugar; nitrogenized substances, like lean meat and eggs, and lastly, fatty substances, like butter. . . . No article of food which does not contain all three of these classes of substances can alone support life for any length of time. A man would starve to death on starch alone, on meat alone, or on butter alone. The relative proportion, however, in which these three classes of substances are required by man depends on his outward circumstances, such as the climate, his physical activity, his occupation, or his peculiar temperament, and to the right balance of his food he is guided by experience.—COOKE *Religion and Chemistry*, ch. 4, p. 104. (S., 1894.)

2886. RESPONSE TO HUMAN FEELINGS SOUGHT IN NATURE—Every imaginative mind looks for reflections of its own deepest feelings in the world about it. The lonely, embittered heart, craving for sympathy, which he cannot meet with in his fellow man, finds traces of it in the sighing of the trees or the moaning of the sad sea wave. Our poet laureate, in his great elegy, has abundantly illustrated this impulse of the imagination to reflect its own emotional coloring on to inanimate things: for example, in the lines:

> The wild unrest that lives in woe
> Would dote and pore on yonder cloud
> That rises upward always higher,
> And onward drags a laboring breast,
> And topples round the dreary west,
> A looming bastion fringed with fire.
> [TENNYSON *In Memoriam*, st. 15, l. 15.]

—SULLY *Illusions*, ch. 9, p. 226. (A., 1897.)

2887. RESPONSIBILITY DESTROYED OR TRANSFERRED—Anything which destroys responsibility or transfers it cannot be other than injurious in its moral tendency and useless in itself.—DRUMMOND *Natural Law in the Spiritual World*, essay 10, p. 325. (H. Al.)

2888. RESPONSIBILITY FOR MENTAL ILLUSIONS — *Coleridge's Unbelief in Ghosts—Resolution Can Hold the Mind to Realities.*—If we only choose to exert ourselves we can always keep our illusions in a nascent or imperfectly developed stage. This applies not only to those half-illusions into which we voluntarily fall, but also to the more irresistible passive illusions, and those arising from an over-excited imagination. Even persons subject to hallucinations, like Nicolai of Berlin, learn to recognize the unreal character of these phantasms. On this point the following bit of autobiography from the pen of Coleridge throws an interesting light. "A lady" (he writes) "once asked me if I believed in ghosts and apparitions. I answered with truth and simplicity, 'No, madam, I have seen far too many myself.'" However irresistible our sense-illusions may be, so long as we are under the sway of particular impressions or mental images, we can, when resolved to do so, undeceive ourselves by carefully attending to the actual state of things about us.—SULLY *Illusions*, ch. 6, p. 125. (A., 1897.)

2889. RESPONSIBILITY OF THE DRUNKARD—*Abstinence a Possibility and a Duty—Ruin Is Criminal Insanity.*—Whatever allowances society may be ready to make for individual cases—such, for instance, as that of Hartley Coleridge, who was the victim of a strong hereditary predisposition, accompanied by a constitutional weakness of will—it recognizes as a fixed conviction, and consistently acts upon that conviction, that the incipient drunkard has a power over himself; that he can not only abstain if he chooses, but that he can choose to abstain because he knows that he ought to do so; and that when, by voluntarily giving way to his propensity, he brings himself into a condition in which he is no more responsible for his actions than a lunatic, he is not thereby exempted from the penalty that may attach to them, but must be held responsible for having knowingly and deliberately brought himself into the condition of irresponsibility. — CARPENTER *Mental Physiology*, pref., p. 42. (A., 1900.)

2890. REST DUE TO A BALANCE OF FORCES—*Duration and Indestructibility of Matter.*—All that we know of matter is inseparably connected with the forces which it exerts, or which it is capable of exerting, or which are being exerted in it. The force of gravitation seems to be all-pervading, and to be either an inherent power or property in every kind, or almost every kind of matter, or else to be the result of some kind of energy which is universal and unquenchable. All bodies, however passive and inert they may seem to be under certain conditions, yet indicate by their very existence the power of those molecular forces to which the cohesion of their atoms is due. The fact is now familiar to us that the most

perfect stillness, and apparent rest, in many forms of matter is but the result of a balance or equilibrium maintained between forces of the most tremendous energy, which are ready to burst forth at a moment's notice, when the conditions are changed under which that balance is maintained. And this principle, which has become familiar in the case of what are called explosive substances, because of the ease and the certainty with which the balanced forces can be liberated, is a principle which really prevails in the composition of all material substances whatever, the only difference being that the energies by which their molecules are held together are so held under conditions which are more stable—conditions which it is much more difficult to change—and conditions, therefore, which conceal from us the universal prevalence and power of force in the constitution of the material universe. It is, therefore, distinctly the tendency of science more and more to impress us with the idea of the unlimited duration and indestructible nature both of matter and of the energies which work in it and upon it.—ARGYLL *Unity of Nature*, ch. 4, p. 80. (Burt.)

2891. REST, UNREAL — *Parasitism Not Christian.*—Whatever rest is provided by Christianity for the children of God, it is certainly never contemplated that it should supersede personal effort. And any rest which ministers to indifference is immoral and unreal — it makes parasites and not men.—DRUMMOND *Natural Law in the Spiritual World*, essay 9, p. 301. (H. Al.)

2892. RESULT, COMBINATION TO SECURE—*Force of Association in Memory—All Circumstances Must Converge upon Hidden Thought.*—The writer of these pages has every year to learn the names of a large number of students who sit in alphabetical order in a lecture-room. He finally learns to call them by name as they sit in their accustomed places. On meeting one in the street, however, early in the year, the face hardly ever recalls the name, but it may recall the place of its owner in the lecture-room, his neighbors' faces, and consequently his general alphabetical position; and then, usually, as the common associate of all these combined data, the student's name surges up in his mind. A father wishes to show to some guests the progress of his rather dull child in kindergarten instruction. Holding the knife upright on the table, he says, "What do you call that, my boy?" "I calls it a knife, I does," is the sturdy reply, from which the child cannot be induced to swerve by any alteration in the form of question, until the father recollecting that in the kindergarten a pencil was used, and not a knife, draws a long one from his pocket, holds it in the same way, and then gets the wished-for answer, "I calls it vertical." All the concomitants of the kindergarten experience had to recombine their effect before the word "vertical" could be reawakened.—JAMES *Psychology*, vol. i, ch. 14, p. 568. (H. H. & Co., 1899.)

2893. RESULT, VAST, FROM SMALL EXPERIMENTS—*Soda from Sea-salt.*—As a single example out of a thousand, take the manufacture of carbonate of soda from sea-salt, more than 200,000 tons of which, of the value of two millions sterling, are annually made in the alkali works of Great Britain. The salt is first converted into sulfate of soda by the action of sulfuric acid; the sulfate of soda is then converted into carbonate of soda by being heated with chalk and carbon. This important substance was formerly manufactured from barilla, and the interesting chemical process now employed on so gigantic a scale was the result of an experiment with substances heated in an evaporating-dish by means of a spirit-lamp.—LOWE *Nature-Studies*, p. 1. (Hum., 1888.)

2894. RESULTS ATTAINED, DUE APPRECIATION OF—It is true that our plummet is not long enough to measure the depths of the sea, but that is no reason why it should lose value for us; if it helps us for the time being to avoid the rocks and the sand-banks, that service is great enough. —LIEBIG *Vorrede zur Thierchemie.* (Translated for *Scientific Side-Lights.)*

2895. RESULTS, NATURAL TO SEEK —*Return Impression Completes Cycle of Activity.*—It would seem only natural to say that, since after acting we normally get some return impression of result, it must be well to let the pupil get such a return impression in every possible case. Nevertheless, in schools where examination marks and "standing" and other returns of result are concealed, the pupil is frustrated of this natural termination of the cycle of his activities, and often suffers from the sense of incompleteness and uncertainty; and there are persons who defend this system as encouraging the pupil to work for the work's sake, and not for extraneous reward. Of course, here, as elsewhere, concrete experience must prevail over psychological deduction. But, so far as our psychological deduction goes, it would suggest that the pupil's eagerness to know how well he does is in the line of his normal completeness of function, and should never be balked except for very definite reasons indeed.—JAMES *Talks to Teachers*, ch. 5, p. 37. (H. H. & Co., 1900.)

2896. RESULTS NOT ACCOUNTED FOR—*Structure of Organic Beings Not Explained by External Conditions.*—It is preposterous to attribute to mere external conditions the structure, for instance, of the woodpecker, with its feet, tail, beak, and tongue so admirably adapted to catch insects under the bark of trees. In the case of the mistletoe, which draws its nourish-

ment from certain trees, which has seeds that must be transported by certain birds, and which has flowers with separate sexes absolutely requiring the agency of certain insects to bring pollen from one flower to the other, it is equally preposterous to account for the structure of this parasite, with its relations to several distinct organic beings, by the effects of external conditions, or of habit, or of the volition of the plant itself.—DARWIN *Origin of Species*, int., p. 3. (Burt.)

2897. RESULTS OF DISTANT CAUSES—*Coal Deposits.*—We find in certain localities subterranean deposits of coal, consisting of vegetable matter, formerly drifted into seas and lakes. These seas and lakes have since been filled up, the lands whereon the forests grew have disappeared or changed their form, the rivers and currents which floated the vegetable masses can no longer be traced, and the plants belonged to species which for ages have passed away from the surface of our planet. Yet the commercial prosperity and numerical strength of a nation may now be mainly dependent on the local distribution of fuel determined by that ancient state of things. —LYELL *Principles of Geology*, ch. 1, p. 2. (A., 1854.)

2898. RESULTS OUTREACHING NARROW LIMITS—*The Mediterranean in History—True Conception of Plato.*—Plato, in his "Phædo," describes the narrow limits of the Mediterranean in a manner that accords with the spirit of enlarged cosmical views. "We, who inhabit the region extending from Phasis to the Pillars of Hercules, occupy only a small portion of the earth," he writes, "where we have settled ourselves round the inner sea like ants or frogs round a swamp." This narrow basin, on the borders of which Egyptian, Phenician, and Hellenic nations flourished and attained to a high degree of civilization, is the point from which the most important historical events have proceeded, no less than the colonization of vast territories in Africa and Asia, and those maritime expeditions which have led to the discovery of the whole western hemisphere of the globe.—HUMBOLDT *Cosmos*, vol. ii, pt. ii, p. 119. (H., 1897.)

2899. RESULTS, SECONDARY, MOST PERNICIOUS — *Bacteria Poison by Their Products—Toxins—Ptomaines.* — From the careful study of a number of epidemics due to food poisoning, this patient observer [Dr. Ballard] was able, without the aid of modern bacteriology, to arrive at a simple principle which must not be forgotten. Food poisoning is due either to bacteria themselves or to their products, which are contained in the substance of the food. In cases of the first kind, bacteria gaining entrance to the human alimentary canal, set up their specific changes and produce their toxins, and by so doing in course of time bring about a diseased condition, with its consequent symptoms. On the other hand, if the products, sometimes called *ptomaines*, are ingested as such, the symptoms set up by their action in the body tissues appear earlier. From these facts Dr. Ballard deduced the simple principle that if there is no incubation period, or at all events a comparatively short space of time between eating the poisoned food and the advent of disease, the agents of the disease are products of bacteria. If, on the other hand, there is an incubation period, the agents are probably bacteria.—NEWMAN *Bacteria*, ch. 6, p. 176. (G. P. P., 1899.)

2900. RESULTS UNINTENDED—*Bradley — Herschel — Fraunhofer—Columbus.*—This method of measuring the distance of the stars by the effect of perspective due to the annual displacement of the earth had already been divined by the astronomers of the last century, and in particular by Bradley, who, in attempting to measure the distance of the stars by observations made at intervals of six months, found another thing. Instead of discovering the distance of the stars, which was the object of his observations, he discovered a very important optical phenomenon—the aberration of light, an effect produced by the combination of the velocity of light with the earth's motion in space. His case was similar to that of William Herschel, who, in searching for the parallax of stars by comparisons between bright stars and their near companions, found the double-star systems; or, like Fraunhofer, who, in seeking the limits of the colors of the solar spectrum, found the rays of absorption, the study of which founded spectrum analysis. The history of the sciences shows us that discoveries have very often been made by researches which are only indirectly related to them. In attempting to reach by the west the eastern frontiers of Asia, Christopher Columbus discovered the New World. He might not have discovered it, and he might not have looked for it, if he had known the true distance from Portugal to Kamchatka.—FLAMMARION *Popular Astronomy*, bk. vi, ch. 5, p. 594. (A.)

2901. ——— ——— *Descartes Supporting Materialism—Animals as Automata—Why Not Man the Same?*—When Descartes denied mind to animals, on the ground that the essence of mind consists in thought, and man is the only thinking being, he could have little imagined that this proposition would do as much as the strictly mechanical views which he represented in natural philosophy to further the doctrines which are the direct opposite of the spiritualism which he taught—the doctrines of modern materialism. If animals are natural automata, and if all the phenomena which general belief refers to sensation, feeling, and will are the result of purely mechanical conditions, why should not the same explana-

tion hold of man? This was the obvious inference which the materialism of the seventeenth and eighteenth centuries drew from Descartes's principles.—WUNDT *Psychology*, lect. 1, p. 5. (Son. & Co., 1896.)

2902. ——— ——— *Indefatigable Patience Rewarded—Quest in One Line Leads to Discovery of a Different Kind.*—Indeed, Schwabe himself was far from anticipating the discovery which fell to his share. He compared his fortune to that of Saul, who, seeking his father's asses, found a kingdom. For the hope which inspired his early resolution lay in quite another direction. His patient ambush was laid for a possible intramercurial planet, which, he thought, must sooner or later betray its existence in crossing the face of the sun. He took, however, the most effectual measures to secure whatever new knowledge might be accessible. During forty-three years his "imperturbable telescope" never failed (weather and health permitting) to bring in its daily report as to how many, or if any, spots were visible on the sun's disk, the information obtained being day by day recorded on a simple and unvarying system. In 1843 he made his first announcement of a probable decennial period [of sun-spots].—CLERKE *History of Astronomy*, pt. ii, ch. 1, p. 156. (Bl., 1893.)

2903. ——— ——— *Machinery Improving Weeds—Difficulty of Cleansing Wheat Increased.*—L. H. Dewey, in the *Year-book* of the Department of Agriculture for the year 1896, p. 276, says: "Cockle-seeds are normally somewhat smaller than wheat-grains. In some parts of the Northwest, where wheat for sowing has been cleaned year after year by steam thrashers, all the cockle-seeds except the largest ones have been removed, and these have been sown until a large-seeded strain has been bred which is very difficult to separate from the wheat."—BEAL *Seed Dispersal*, ch. 8, p. 81. (G. & Co., 1898.)

2904. RESULTS, UNNOTICED, OF QUIET, PERSISTENT ACTION—*Thermal Springs Bring Material from Depths of the Earth.*—Nor are thermal springs by any means ineffective agents in bringing material from the interior of the earth's crust and depositing it at the surface. The Bath spring contains various saline substances, principally sulfates and chlorids, in solution in its waters. These are quietly carried by rivers to the sea, and are lost to our view. The spring has certainly maintained its present condition since the time of the Romans, and I find that if the solid materials brought from the interior of the earth during the last 2,000 years had been collected they would form a solid cone equal in height to Monte Nuovo. Yet we usually regard the Campi Phlegræi as a powerfully active volcanic district, and the subterranean action in our own country as quite unworthy of notice.—JUDD *Volcanoes*, ch. 8, p. 219. (A., 1899.)

2905. REVELATION ALLOWS ROOM FOR NATURAL LAW—*"The Dust of the Ground."*—But what of revelation? Are its history and doctrines incompatible with the belief that God uniformly acts through the use of means? The narrative of creation is given to us in abstract only, and is told in two different forms, both having apparently for their main, perhaps their exclusive, object the presenting to our conception the personal agency of a living God. Yet this narrative indicates, however slightly, that room is left for the idea of a material process. "Out of the dust of the ground"—that is, out of the ordinary elements of Nature—was that body formed which is still upheld and perpetuated by organic forces acting under the rules of law. Nothing which science has discovered or can discover is capable of traversing that simple narrative.—ARGYLL *Reign of Law*, ch. 1, p. 16. (Burt.)

2906. REVELATION OF GOD IN NATURE—It is a noble object that invites us to these annual gatherings. Leaving the broils of the world to others, we come to contemplate together the teachings of God in Nature. We come with faith in that word which is written around and within us, believing in the truthfulness of the revelation, and knowing that he who approaches it with an inquiring, teachable spirit, ever wakeful to the still, small voice, and forgetful of ambitious self, shall find the truth, and feel its benign influence. We aim to decipher some new words in the volume of Nature, that we may learn the will of Him who has ordered all things well, and comprehend more fully his laws in the government of the universe.—DANA *Address as President of the Association for 1854* (*Proceedings of the Amer. Assoc. for the Advancement of Science, 1855*, vol. ix, p. 1).

2907. REVELATION OF THE UNKNOWN—*Depths of Sea Till Lately Unexplored.*—The bottom of the deep sea was until quite recently one of the *terræ incognitæ*. It was regarded by most persons, when it entered into their minds to consider it at all, as one of those regions about which we do not know anything, never shall know anything, and do not want to know anything.—HICKSON *Fauna of the Deep Sea*, pref., p. 7. (A., 1894.)

2908. REVELATIONS OF THE SPECTROSCOPE—*Stars Proved To Be Suns—Minerals Found in the Stars—Unity of the Universe—Stars and Nebulæ Discriminated.*—The immediate effect of the application of the spectroscope to the stars was very striking. The supposition that they were suns became a certainty, since they gave spectra similar in character and often very closely resembling in detail that of our sun. Aldebaran is one of the most sunlike stars, being yellow in color and possessing lines which indicate most of the elements found in the sun. White stars,

such as Sirius and Vega, show hydrogen lines only; and these are supposed to be hotter than our sun, and in an earlier stage of development, while red stars are supposed to be cooling. Other explanations of these facts have, however, been suggested. Much information has also been obtained as to the nature of the nebulæ. Sir William Herschel supposed that they were all really star-clusters, but so enormously remote that even the most powerful telescopes could not render visible the stars composing them. Later observations have shown that many of them do consist of stars, or star-dust, as it has been called; and this seemed to support the theory that all were so composed, including the Milky Way. A study of the distribution of stars and nebulæ by Proctor and others led, however, to the conclusion that they were often really connected, and that nebulæ were not, on the average, more distant than stars: and this view has been confirmed by the spectroscope, which has shown them often to consist of glowing gas; and this is especially the characteristic of all those situated in or near the Milky Way. The first great result of spectrum analysis has thus been to demonstrate the real nature of many stars and nebulæ, to determine some of the elements of which they are formed, and to give us some indications of the changes they have undergone, and thus help us toward a general theory of the development of the stellar universe.—WALLACE *The Wonderful Century*, ch. 6, p. 43. (D. M. & Co., 1899.)

2909. REVELATIONS OF THE TELESCOPE FRAGMENTARY—*Each View but of a Narrow Field—A Human Eye with Telescopic Power Could Get the Perspective of the Heavens—Science Seeks to Present Such a Scene to the Mind's Eye.*—If the human eye could suddenly obtain the power of telescopic vision, those wealths of star-strewing which it is the province of star-gaging to measure would be revealed to our view, not piecemeal, as under telescopic scrutiny, but at once as in a grand celestial panorama. Those varieties of distribution to which Herschel applied his resolution test would be clearly recognized. Here the stars would be seen spread richly over a region of the heavens, but clearly separated from each other; elsewhere would be regions where the stars would more closely cluster, tho still separately discernible; but in parts of the heavens veritable star-clouds would be seen, regions where the stars gather so closely together that even the enhanced powers of vision I have imagined—nay, tho the power of the Rosse telescope had been acquired by man —would fail to show discrete stars, the sky in those parts being aglow with condensed starlight, on which, as on a splendid background, brighter stars would be seen spread with inconceivable richness.

Such a scene might not be intelligible at a first view; it might even baffle all attempts at interpretation, all efforts to estimate the relative distances and proportions of its several parts. But our only path to the solution of the noblest problem in science is by presenting to the mind's eye such a picture of the great star-strewn sphere which surrounds us on all sides; when that has been done we shall begin to know whether the great problem is altogether beyond our mastery.—PROCTOR *Expanse of Heaven*, pp. 262-3. (L. G. & Co., 1897.)

2910. REVERENCE FOR ANTIQUITY—*Decline of, under Modern Civilization.*—The whole country [of Denmark] appears to have been, at one time, thickly studded with tumuli; where the land has not been brought into cultivation, many of them are often in sight at once, and even in the more fertile and thickly populated parts the plow is often diverted from its course by one of these ancient burial-places. Fortunately, the stones of which they are constructed are so large and so hard that their destruction and removal is a laborious and expensive undertaking. While, however, on the one hand, land grows gradually more valuable, and the stones themselves are more and more coveted for building or other purposes; on the other, the conservative traditions, the feeling of superstitious reverence for the dead, which have so long protected them from desecration, is gradually becoming weaker; and it is estimated that not a day passes without witnessing the destruction of one or more of these tumuli, and the loss of some, perhaps almost irrecoverable, link in the history of the human race.—AVEBURY *Prehistoric Times*, ch. 7, p. 213. (A., 1900.)

2911. REVERENCE GROWS WITH KNOWLEDGE OF NATURE — *Sublimity Not the Product of Ignorance.*—The fear [is] entertained by some persons that Nature may by degrees lose a portion of the charm and magic of her power as we learn more and more how to unveil her secrets. . . . It is true that, properly speaking, the forces of Nature can only exercise a magical power over us as long as their action is shrouded in mystery and darkness, and does not admit of being classed among the conditions with which experience has made us acquainted. The effect of such a power is, therefore, to excite the imagination, but that, assuredly, is not the faculty of mind we would evoke to preside over the laborious and elaborate observations by which we strive to attain to a knowledge of the greatness and excellence of the laws of the universe. The physical philosopher measures with admirable sagacity the waves of light of unequal length which by interference mutually strengthen or destroy each other, even with respect to their

chemical actions; the astronomer, armed with powerful telescopes, penetrates the regions of space, contemplates, on the extremest confines of our solar system, the satellites of Uranus, or decomposes faintly sparkling points into double stars differing in color. The botanist discovers the constancy of the gyratory motion of the chara in the greater number of vegetable cells, and recognizes in the genera and natural families of plants the intimate relations of organic forms. The vault of heaven, studded with nebulæ and stars, and the rich vegetable mantle that covers the soil in the climate of palms, cannot surely fail to produce on the minds of these laborious observers of Nature an impression more imposing and more worthy of the majesty of creation than on those who are unaccustomed to investigate the great mutual relations of phenomena. I cannot, therefore, agree with Burke when he says, "it is our ignorance of natural things that causes all our admiration, and chiefly excites our passions."—HUMBOLDT *Cosmos*, vol. i, int., p. 39. (H., 1897.)

2912. REVERSAL OF GENERAL RULE—*Snow-line Highest on Northern Slope of Himalayas—Monsoons Pile Waters of Indian Ocean on the Southern Side of the Mountains.*—Since the time of Humboldt attention has frequently been drawn to the fact that in those mountains [the Himalayas] the snow-line is higher on the north or colder side than on the southern and therefore warmer slopes. The amount of the difference has been variously estimated by various observers, but there appears to be no doubt of the fact that the relative difference is as stated, not the reverse. And it is not difficult to understand why it should be so. The southern slopes, tho the warmer, are exposed to the moisture-laden monsoons which blow from the south during half the year in India, and at a certain elevation this moisture is precipitated in the form of snow. The northern slopes, on the other hand, are swept only by the comparatively dry winds that have crossed the interior of Asia, and hence the accumulations of snow in the course of the year are immensely greater on the south side than on the north. On the former side the power of the sun on the Himalayas, just as on the Alps, is greater in causing the snow to disappear, but as there is much more snow on that side to be removed in the intervals between the deposition of fresh snow, the line up to which its total disappearance can be effected is lower there than on the north.—CHISHOLM *Nature-Studies*, p. 34. (Hum., 1888.)

2913. REVERSION IN AGE TO FAULTS OF YOUTH—*Deep Meaning of Second Childhood—Importance of Early Impressions.*—The science of statistics shows that certain crimes which are common in the seasons of youth disappear, comparatively, with advancing age, and reappear again toward the close of life; or, in other words, that the tendencies to indulgences in disorders of imagination, and habits which were acquired in the early life of a vicious youth, or one exposed to evil associations, tho they may be masked and kept in subjection by the judgment and the influences of position and reputation during early manhood, middle life, and first decline, resume their sway and close the career of the man who has perhaps for years sustained a spotless reputation—with ignominy and shame. How frequently do cases of this kind present themselves! I have now in my mind's eye an individual who for forty years was known and esteemed as a model of honor, purity, and integrity, but who at the age of seventy committed a crime which consigned his name to infamy. Depend upon it, this man was subjected to evil influences in early life, and the impressions then made, tho neutralized by the conditions and circumstances which afterwards surrounded him, were never effaced, and, when the latter ceased to produce their restraining effects, the former resumed their original sway. Pursuing this train of thought we would conclude that the child is not merely the father of the man, but, more emphatically, the father of the old man; that the term "second childhood" has a more extended signification than that of the mere decline of the faculties. It also should convey the idea that the tendency of the dispositions and propensities of individuals is to return to the condition of earlier life.—HENRY *Thoughts on Education* (*Scientific Writings*, vol. i, p. 341). (Sm. Inst., 1886.)

2914. REVERSION TO ANCESTRAL FORMS—*Enduring Power of Type—The Stripe in Horses.*—By the term "reversion" or "atavism" we understand the remarkable fact known to all breeders of animals, that occasionally single and individual animals assume a form which has not existed for many generations, but belongs to a generation which has long since disappeared. One of the most remarkable instances of this kind is the fact that in some horses there sometimes appear singular dark stripes, similar to those of the zebra, quagga, and other wild species of African horses. Domestic horses of the most different races and of all colors sometimes show such dark stripes: for example, a stripe along the back, a stripe across the shoulders, and the like. The sudden appearance of these stripes can only be explained by the supposition that it is the effect of a latent transmission, a relapse into the ancient original form, which has long since vanished, and was once common to all species of horses; the original form, undoubtedly, was originally striped like the zebras, quaggas, etc. —HAECKEL *History of Creation*, vol. i, ch. 9, p. 214. (K. P. & Co., 1899.)

2915. REVOLUTION IN ASTRONOMY—*New Centering of the Solar System by Copernicus.*—The fundamental views of Copernicus have indicated to theoretical astronomy paths which could not fail to lead to sure results. . . . "By no other arrangement," he exclaims with enthusiasm, "have I been able to find so admirable a symmetry of the universe, and so harmonious a connection of orbits, as by placing the lamp of the world *(lucernam mundi)*, the Sun, in the midst of the beautiful temple of Nature as on a kingly throne, ruling the whole family of circling stars that revolve around him *(circumagentem gubernans astrorum familiam)*." Even the idea of universal gravitation or attraction *(appetentia quædam naturalis partibus indita)* toward the sun as the center of the world *(centrum mundi)*, and which is inferred from the force of gravity in spherical bodies, seems to have hovered before the mind of this great man, as is proved by a remarkable passage in the 9th chapter of the 1st book [of] "De Revolutionibus."—HUMBOLDT *Cosmos*, vol. ii, pt. ii, pp. 305, 308. (H., 1897.)

2916. REWARDS OF EARLY INVENTORS—*The First Patent.*—The earliest invention was a single homogeneous act, an original suggestion, a happy thought. The patent on this was an immediate and individual benefit. A sharper knife of flint, a better scraper, a longer spear, a stouter thread wrought better, and the reward was more execution. Now, the man who made the best weapons killed the most game, from that game he got better food, that food made him stronger, that strength made him chief, that chieftaincy gave him more wives, more children, more cohorts to support his throne. The best woman to cook or sew or carry loads got the best husband; that was her patent. From these simple methods of inventing and rewarding invention we come on to the Olympic games, the monopolies, the patent system. And now, in the inventor's laboratory of Graham Bell or Edison the climax is reached, where one machine is the cooperative result of any number of trained minds, and the reward is meted out to each by the manufacturer.—MASON *The Birth of Invention (Address at Centenary of American Patent System, Washington, D. C., 1891; Proceedings of the Congress*, p. 411).

2917. RHYTHM OF THOUGHT LIKE PERIODS OF LANGUAGE—*Intervals between Sentences Full of Meaning.*—As we take, in fact, a general view of the wonderful stream of our consciousness, what strikes us first is this different pace of its parts. Like a bird's life, it seems to be made of an alternation of flights and perchings. The rhythm of language expresses this, where every thought is expressed in a sentence, and every sentence closed by a period. The resting-places are usually occupied by sensorial imaginations of some sort, whose peculiarity is that they can be held before the mind for an indefinite time, and contemplated without changing; the places of flight are filled with thoughts of relations, static or dynamic, that for the most part obtain between the matters contemplated in the periods of comparative rest.—JAMES *Psychology*, vol. i, ch. 9, p. 243. (H. H. & Co., 1899.)

2918. RICHES OF CREATIVE POWER INEXHAUSTIBLE—*Wonderfully Varied Light of Colored Suns.*—The colors of the double stars, then, are real, so that if we could pay a visit to one of these pairs we should find colored suns—red, orange, and yellow ruling suns, and green, purple, or blue minor suns, or, as the case might be, lilac, puce, mauve, russet, or olive suns of the smaller sort. Nor must we think of these smaller suns as really small in themselves. It is only by comparison with the leading orbs of unequal pairs that the lesser is called small. In reality it is probable that many of the lesser suns of these double systems are very much larger than all the planets of the solar system together.—PROCTOR *Expanse of Heaven*, p. 222. (L. G. & Co., 1897.)

2919. RICHES OF SCIENCE NOT TO BE WASTED—*Revelation of Nature Must Help Religion.*—It is impossible to believe that the amazing succession of revelations in the domain of Nature during the last few centuries, at which the world has all but grown tired wondering, are to yield nothing for the higher life. If the development of doctrine is to have any meaning for the future, theology must draw upon the further revelation of the seen for the further revelation of the unseen. It need, and can, add nothing to fact; but as the vision of Newton rested on a clearer and richer world than that of Plato, so, tho seeing the same things in the spiritual world as our fathers, we may see them clearer and richer. With the work of the centuries upon it, the mental eye is a finer instrument, and demands a more ordered world.—DRUMMOND *Natural Law in the Spiritual World*, int., p. 29. (H. Al.)

2920. RIDDLE OF ATTRACTION OF AMBER—*Dawning Study of Electricity.*—The sphinx of the centuries follows the flies and the reptiles into the golden recesses of the amber, and there enthroned poses once more the nature of the amber soul as a new riddle. There is no kinship between this evanescent energy drawn from these yellow depths and the stolid pull of the dull stone, no similarity between the wayward and mastering spirit which seizes upon anything within its strength and the unrelenting tyranny with which the magnet enforces servitude only upon the stubborn iron. What, then, is this genius which is called forth by the friction of the amber,

even as the afrit was summoned by the rubbing of Aladdin's lamp? Thus the question first asked twenty-two hundred years before was renewed, and now impressed with greater urgency than ever upon the newly awakened human intellect [in the sixteenth century].—PARK BENJAMIN *Intellectual Rise in Electricity*, ch. 9, p. 252. (J. W., 1898.)

2921. RIGHT WINS ITS OWN CONQUEST—*Will Has Only To Hold It Steadily at the Front.*—When our impulsive feeling is hot . . . it is hard to hold the right idea steadily enough before the attention to let it exert its adequate effects. Whether it be stimulative or inhibitive, it is too reasonable for us; and the more instinctive passional propensity then tends to extrude it from our consideration. We shy away from the thought of it. It twinkles and goes out the moment it appears in the margin of our consciousness, and we need a resolute effort of voluntary attention to drag it into the focus of the field, and to keep it there long enough for its associative and motor effects to be exerted. . . . Once brought, however, in this way to the center of the field of consciousness and held there, the reasonable idea will exert these effects inevitably; for the laws of connection between our consciousness and our nervous system provide for the action then taking place. Our moral effort, properly so called, terminates in our holding fast to the appropriate idea.—JAMES *Talks to Teachers*, ch. 15, p. 186. (H. H. & Co., 1900.)

2922. RISE AND FALL OF ANCIENT LANDS—*Forests Submerged—New Vegetation Succeeding (Ps. cvii, 33, 35).*—In some of the deeper coal-beds there is a regular alternation between layers of coal and layers of sand or clay; in certain localities as many as ten, twelve, and even fifteen coal-beds have been found alternating with as many deposits of clay or mud or sand; and in some instances, where the trunks of the trees are hollow and have been left standing erect, they are filled to the brim, or to the height of the next layer of deposits, with the materials that have been swept over them. Upon this set of deposits comes a new bed of coal with the remains of a new forest, and above this again a layer of materials left by a second freshet, and so on through a number of alternate strata. It is evident from these facts that there has been a succession of forests, one above another, but that in the intervals of their growth great floods have poured over the marshes, bringing with them all kinds of loose materials, such as sand, pebbles, clay, mud, lime, etc., which, as the freshets subsided, settled down over the coal, filling not only the spaces between such trees as remained standing, but even the hollow trunks of the trees themselves.—AGASSIZ *Geological Sketches*, ser. i, ch. 3, p. 84. (H. M. & Co., 1896.)

2923. RISE IN GRADE OF LIFE—*Insect Life Shows the Gradation.*—Take a homely and very familar example, that of the branch of articulates. Naturalists divide this branch into three classes—Insects, *Crustacea*, and Worms; and most of them tell you that worms are lowest, *Crustacea* next in rank, and that insects stand highest, while others have placed the *Crustacea* at the head of the group. We may well ask why. Why does an insect stand above a crustacean, or vice versa; why is a grasshopper or a butterfly structurally superior to a lobster or a shrimp? . . . But when we study the gradual development of the insect, and find that in its earliest stages it is wormlike, in its second, or chrysalis stage, it is crustacean-like, and only in its final completion it assumes the character of a perfect insect, we have a simple natural scale by which to estimate the comparative rank of these animals.—AGASSIZ *Journey in Brazil*, ch. 1, p. 21. (H. M. & Co.)

2924. RIVERS CLARIFIED BY PASSING THROUGH LAKES—*Purity of Niagara's Torrent—The Rhone Flows Clear from Lake of Geneva.*—The fact that bodies of standing water retain the mineral matter brought to them in suspension is illustrated more or less perfectly in nearly every lake and pond, and even by ephemeral pools by the wayside, but is especially marked in great seas like those drained by the St. Lawrence. During storms all of the streams pouring into the upper Laurentian lakes, from the surface drainage of the land, are brown and heavy with mud, but the water rushing over Niagara remains of the same deep greenish-blue tint season after season and year after year. Niagara River, above the falls, and the St. Lawrence, are surface streams, because their clear waters have but slight power of corrasion; it is for this reason that during the centuries they have occupied their present channels they have not materially deepened them.

In the case of lakes fed by the turbid waters from glaciers the part they play as settling-basins is even more strikingly shown than in the instances just cited. Lake Geneva, Switzerland, fed by the silt-laden waters of the Rhone, is discolored for several miles from where the river enters, but when the waters leave the lake and again start on their journey they are wonderfully clear. An abundance of similar illustrations is furnished by the glacial-fed lakes of the Sierra Nevada and Cascade mountains and by some of the numerous lakes on the head waters of the Yukon.—RUSSELL *Lakes of North America*, ch. 2, p. 39. (G. & Co., 1895.)

2925. RIVERS IN THEIR WILD STATE—*Maps Change from Year to Year.*—The greatest changes are shown by rivers in their wild state—that is, where they divide into numerous arms and may be said to dissolve into separate veins, as may be

witnessed wherever a stream plunges from the mountains immediately into a plain. The Rhine runs wild as it enters the upper Rhine plateaux, the Bode does the same at the north foot of the Harz, the Inn as it forsakes the Alps. Throughout such regions scarcely a year elapses without one arm or another disappearing, while other branches are formed. Successive maps, therefore, show very different pictures of the stream.—PEUCK *Oberflächenbau, Anleitung zur Landes- und Volksforschung*, p. 29. (Translated for *Scientific Side-Lights.)*

2926. RIVERS IN THE OCEAN—*The Gulf Stream.*—The narrow currents or true oceanic rivers which traverse the sea bring warm water into higher and cold water into lower latitudes. To the first class belongs the celebrated Gulf Stream, which was known to Anghiera, and more especially to Sir Humphrey Gilbert in the sixteenth century. Its first impulse and origin are to be sought to the south of the Cape of Good Hope; after a long circuit it pours itself from the Caribbean Sea and the Mexican Gulf through the Straits of the Bahamas, and, following a course from south-southwest to north-northeast, continues to recede from the shores of the United States, until, further deflected to the eastward by the banks of Newfoundland, it approaches the European coasts, frequently throwing a quantity of tropical seeds *(Mimosa scandens, Guilandina bonduc, Dolichos urens)* on the shores of Ireland, the Hebrides, and Norway. The northeastern prolongation tends to mitigate the cold of the ocean, and to ameliorate the climate on the most northern extremity of Scandinavia.—HUMBOLDT *Cosmos,* vol. i, p. 307. (H., 1897.)

2927. RIVERS LIFTED BY THE SUN—*Heat Restored in Downward Flow.*—Late discoveries have taught us that winds and rivers have their definite thermal values, and that, in order to produce their motion, an equivalent amount of solar heat has been consumed. While they exist as winds and rivers, the heat expended in producing them has ceased to exist, being converted into mechanical motion; but when that motion is arrested, the heat which produced it is restored. A river, in descending from an elevation of 7,720 feet, generates an amount of heat competent to augment its own temperature 10° F., and this amount of heat was abstracted from the sun, in order to lift the matter of the river to the elevation from which it falls. As long as the river continues on the heights, whether in the solid form as a glacier or in the liquid form as a lake, the heat expended by the sun in lifting it has disappeared from the universe. It has been consumed in the act of lifting. But at the moment that the river starts upon its downward course, and encounters the resistance of its bed, the heat expended in its elevation begins to be restored. The mental eye, indeed, can follow the emission from its source; through the ether as vibratory motion; to the ocean, where it ceases to be vibration, and assumes the potential form, among the molecules of aqueous vapor; to the mountain-top, where the heat absorbed in vaporization is given out in condensation, while that expended by the sun in lifting the water to that elevation is still unrestored. This we find paid back to the last unit: by the friction along the river's bed; at the bottom of the cascades where the plunge of the torrent is suddenly arrested; in the warmth of the machinery turned by the river; in the spark from the millstone; beneath the crusher of the miner [or] in the Alpine sawmill.—TYNDALL *Heat a Mode of Motion,* lect. 17, p. 527. (A., 1900.)

2928. RIVERS OF ICE—*The Glacier Flows Like a Stream—No Sharp Line Divides Different States of Matter.*—As might be expected from these varied phenomena, it has been found that there is no such sharp line of distinction between the various states of matter as is popularly supposed; some of the properties which are characteristic of matter in one state being present in a less degree in other states. Viscous bodies, for example, often present phenomena characteristic of both solids and fluids. Sealing-wax, pitch, and ice are all brittle at low temperatures, resembling in this respect such solids as glass and stone: but they are at the very same time fluid, if time enough is allowed to exhibit the phenomenon. This is seen in the motion of glaciers, which move in every respect like true fluids, even to the middle of the stream flowing quicker than the sides, and the top than the bottom. Eddies and whirls occur in glaciers as in rivers, and also upward and downward motion, so that rocks torn off the glacier floor may be carried upward and deposited on surfaces hundreds of feet above their place of origin.—WALLACE *The Wonderful Century,* ch. 7, p. 55. (D. M. & Co., 1899.)

2929. RIVERS, TRANSPORTING POWER OF—*Earth Carried from Mountains to Sea.*—The quantity of mud held in suspension by the waters of the Ganges and Brahmaputra is found, as might be expected, to exceed that of any of the rivers alluded to in this or the preceding chapters; for, in the first place, their feeders flow from mountains of unrivaled altitude, and do not clear themselves in any lakes, as does the Rhine in the Lake of Constance, or the Rhone in that of Geneva. And, secondly, their whole course is nearer the equator than that of the Mississippi or any great river respecting which careful experiments have been made to determine the quantity of its water and earthy contents. The fall of rain, moreover, as we have before seen, is excessive on the southern flanks of the first range of mountains which

rise from the plains of Hindustan, and still more remarkable is the quantity sometimes poured down in one day. The sea, where the Ganges and Brahmaputra discharge their main stream at the flood season, only recovers its transparency at the distance of from 60 to 100 miles from the delta; and we may take for granted that the current continues to transport the finer particles much farther south than where the surface-water first becomes clear.—LYELL *Principles of Geology*, ch. 18, p. 278. (A., 1854.)

2930. RIVERS USE ROCK-DÉBRIS TO CUT DOWN OTHER ROCKS—Rivers are much more than mere transporters of sediment. Just as in desert lands wind employs disintegrated rock material as a sand-blast, so rivers use their stones, grit, and sand as tools with which to rasp, file, and undermine the rocks over which they flow. In this way their channels are gradually deepened and widened.—GEIKIE *Earth Sculpture*, ch. 2, p. 34. (G. P. P., 1898.)

2931. ROBBER-BARON OF THE AIR—*Eagle and Fish-hawk.*—What an inspiring sight it is to see one [an osprey, or fish-hawk] plunge from the air upon its prey! One can sometimes hear the splash half a mile or more, and the bird is quite concealed by the spray. It is a magnificent performance, and when, after shaking the water from his plumage, he rises into the air, I am always tempted to applaud.

The osprey, or fish-hawk, as he is also called, adheres closely to a finny diet; neither flesh nor fowl appears on his menu, and he is consequently a migratory bird, coming in April when the ice is melted, and remaining until October. In favorable localities he nests in colonies, returning year after year to the same nest.

One master, it is true, the osprey has, tho he makes a most unwilling servant. The bald-headed eagle is often an appreciative observer of the osprey's piscatorial powers, which so far exceed his own that he wisely, if unjustly, profits by them. Pursuing the osprey, he forces him to mount higher and higher until the poor bird in despair drops his prize, which the eagle captures as it falls.—CHAPMAN *Bird-Life*, ch. 7, p. 122. (A., 1900.)

2932. ——— ——— *Swiftness and Dexterity of the White-headed Eagle.*—The white-headed eagle has also developed the plundering instinct in great perfection, as is shown by the following graphic account of Audubon: "During spring and summer the white-headed eagle, to procure sustenance, follows a different course, and one much less suited to a bird apparently so well able to supply itself without interfering with other plunderers. No sooner does the first hawk make its appearance along the Atlantic shore or around the numerous and large rivers, than the eagle follows it, and, like a selfish oppressor, robs it of the hard-earned fruits of its labor. Perched on some tall summit, in view of the ocean or of some watercourse, he watches every motion of the osprey while on the wing. When the latter rises from the water, with a fish in its grasp, forth rushes the eagle in pursuit. He mounts above the fish-hawk, and threatens it by actions well understood; when the latter, fearing perhaps that its life is in danger, drops its prey. In an instant the eagle, accurately estimating the rapid descent of the fish, closes its wings, follows it with the swiftness of thought, and the next moment grasps it. The prize is carried off in silence to the woods, and assists in feeding the ever-hungry brood of the eagle."—ROMANES *Animal Intelligence*, ch. 10, p. 284. (A., 1899.)

2933. ROCK A SURE FOUNDATION—*Earthquake Resisted by.*—It would seem the harder rocks form better foundations than the softer ones. One explanation of this appears to lie in the fact that soft strata may be in a state of unstable equilibrium, and, by shaking, it is caused to settle. Another explanation is that in hard ground or rock, altho the motion is more rapid than on soft ground, this is more than compensated for by the smallness of the range of motion in the former foundation.—MILNE *Earthquake*, ch. 7, p. 131. (A., 1899.)

2934. ROCKS ROUNDED BY WAVES OF ANCIENT SEA—We raised another block in a different part of the quarry, and found that the area of a circular depression in the stratum below was broken and flawed in every direction, as if it had been the bottom of a pool recently dried up, which had shrunk and split in the hardening. Several large stones came rolling down from the diluvium in the course of the afternoon. They were of different qualities from the sandstone below and from one another; and, what was more wonderful still, they were all rounded and water-worn, as if they had been tossed about in the sea, or the bed of a river, for hundreds of years. There could not, surely, be a more conclusive proof that the bank which had enclosed them so long could not have been created on the rock on which it rested. No workman ever manufactures a half-worn article, and the stones were all half-worn! And if not the bank, why then the sandstone underneath?—MILLER *The Old Red Sandstone*, ch. 1, p. 7. (G. & L., 1851.)

2935. ROCKS, THICKNESS OF, ON OCEAN FLOOR — *Check of Radiant Heat Causes Outburst of Volcano—Repression Prepares for Outbreak.*—If the reader has any difficulty in conceiving the effects of overlaid beds in bringing about a high temperature in strata, he may help himself by a homely comparison. Let him imagine a vessel containing hot water exposed to the

cold and covered with felt or other non-conducting material; the surface of this covering will have a certain temperature. If now this vessel be covered with another thickness of felt, the temperature of the original surface will rise, and a certain gain of its heat will be made by each additional coating of non-conductive material.

The only serious question is as to the thickness of the rocks which have been laid down on the sea-floors. Hardly any geologist will doubt that it is entirely within bounds to assume that thickness much to exceed twenty miles.—SHALER *Aspects of the Earth*, p. 82. (S., 1900.)

2936. ROENTGEN RAYS DEFY REFLECTION OR REFRACTION—*A Force Not To Be Diverted.*—An exceptional property of these rays is that they cannot be either refracted or reflected as can ordinary light and heat. Hence it is only the shadow that can be photographed. And another curious result of this is that they can pass through a powder as easily as through a solid; whereas ordinary light cannot pass through powdered glass or ice, owing to the innumerable reflections and refractions which soon absorb all the rays except those reflected from a very thin surface layer. Proportionate thicknesses of aluminum or zinc, whether in the solid plate or in powder, are equally transparent to these singular rays.—WALLACE *The Wonderful Century*, ch. 5, p. 41. (D. M. & Co., 1899.)

2937. ROMANCE OF ZOOLOGY—*Slaveholding Ants.*—Some species of ants keep slaves—for instance, the reddish ant found in the meadows of Switzerland and Alsace *(Polyergus rufescens).* It is not a large, but a strong species, which has adopted the habit of sallying forth in troops from time to time to make raids upon and plunder the nests of some weaker species, such as the common *Formica fusca*. The object is, however, not to destroy or devour the ants they attack, but merely to carry off the pupæ to their own nest, where they receive every care; the workers hatched from them are then employed as servants, or, to use the usual term, as slaves. These slaves fulfil all the duties of the nest, which would otherwise have fallen to the share of the red workers; they feed the larvæ, build galleries and chambers, bring in food-supplies, and even feed their lazy masters! This is no fable, as was once thought, but an ascertained fact, proved to be such early in this century by Huber of Geneva; a celebrated observer of ants, and since fully confirmed by his pupil and successor, Auguste Forel, as well as by Sir John Lubbock. I have also convinced myself of the truth of the assertion.—WEISMANN *Heredity*, vol. ii, ch. 9, p. 25. (Cl. P., 1897.)

2938. ROOTS MAKING THEIR WAY IN THE SOIL—*Tip of Radicle a Wonderful Structure—Final Purpose of Its Various Movements.*—We believe that there is no structure in plants more wonderful, as far as its functions are concerned, than the tip of the radicle. If the tip be lightly pressed or burnt or cut it transmits an influence to the upper adjoining part, causing it to bend away from the affected side; and, what is more surprising, the tip can distinguish between a slightly harder and softer object, by which it is simultaneously pressed on opposite sides. If, however, the radicle is pressed by a similar object a little above the tip, the pressed part does not transmit any influence to the more distant parts, but bends abruptly towards the object. If the tip perceives the air to be moister on one side than on the other, it likewise transmits an influence to the upper adjoining part, which bends towards the source of moisture. When the tip is excited by light (tho in the case of radicles this was ascertained in only a single instance) the adjoining part bends from the light, but when excited by gravitation the same part bends towards the center of gravity. In almost every case we can clearly perceive the final purpose or advantage of the several movements. Two, or perhaps more, of the exciting causes often act simultaneously on the tip, and one conquers the other, no doubt, in accordance with its importance for the life of the plant. The course pursued by the radicle in penetrating the ground must be determined by the tip, hence it has acquired such diverse kinds of sensitiveness. It is hardly an exaggeration to say that the tip of the radicle thus endowed, and having the power of directing the movements of the adjoining parts, acts like the brain of one of the lower animals, the brain being seated within the anterior end of the body, receiving impressions from the sense-organs, and directing the several movements.—DARWIN *Power of Movement in Plants*, ch. 12, p. 576. (A., 1900.)

2939. ROYALTY AMONG BEES—*The Queen Feared, yet Restrained.*—The victorious queen now presented a very singular spectacle. She approached a royal cell and took this moment for uttering the sound and assuming that posture which strikes the bees motionless. For some minutes it seemed as if she would profit by the dread exhibited by the workers on guard, open the cell and destroy the young female. She also prepared to mount the cell, but in doing that she ceased to make the sound, and quitted the attitude that paralyzes the bees. Then, instantly, the guardians of the cell took courage, and by means of tormenting and biting the queen, caused her to retreat. —HUBER *Nouvelles Observations sur les Abeilles*, p. 117. (Translated for *Scientific Side-Lights.)*

2940. SACRIFICE OF GEM TO SCIENCE—*Burning of a Diamond in Oxygen.*—Faraday thus describes the burning of a diamond in oxygen by the concentrated rays of

the sun. It was effected at Florence, in presence of Sir Humphry Davy, on Tuesday, the 27th of March, 1814: "To-day we made the grand experiment of burning the diamond, and certainly the phenomena presented were extremely beautiful and interesting. A glass globe containing about 22 cubical inches was exhausted of air, and filled with pure oxygen. The diamond was supported in the center of this globe. The Duke's burning-glass was the instrument used to apply heat to the diamond. It consists of two double convex lenses, distant from each other about 3½ feet; the large lens is about 14 or 15 inches in diameter, the smaller one about 3 inches in diameter. By means of the second lens the focus is very much reduced, and the heat, when the sun shines brightly, rendered very intense. The diamond was placed in the focus and anxiously watched. On a sudden Sir H. Davy observed the diamond to burn visibly, and when removed from the focus it was found to be in a state of active and rapid combustion."—TYNDALL *Lectures on Light*, lect. 5, p. 172. (A., 1898.)

2941. SACRIFICE OF LESS FOR GREATER—*Of Present for Future, Personal for Social, Material for Spiritual.*—Men have arranged the various selves which they may seek in an hierarchical scale according to their worth. A certain amount of bodily selfishness is required as a basis for all the other selves. But too much sensuality is despised, or at best condoned on account of the other qualities of the individual. The wider material selves are regarded as higher than the immediate body. He is esteemed a poor creature who is unable to forego a little meat and drink and warmth and sleep for the sake of getting on in the world. The social self as a whole, again, ranks higher than the material self as a whole. We must care more for our honor, our friends, our human ties, than for a sound skin or wealth. And the spiritual self is so supremely precious that, rather than lose it, a man ought to be willing to give up friends, and good fame, and property, and life itself.

In each kind of self, material, social, and spiritual, men distinguish between the immediate and actual, and the remote and potential, between the narrower and the wider view, to the detriment of the former and advantage of the latter. One must forego a present bodily enjoyment for the sake of one's general health; one must abandon the dollar in the hand for the sake of the hundred dollars to come; one must make an enemy of his present interlocutor if thereby one makes friends of a more valued circle; one must go without learning, and grace, and wit, the better to compass one's soul's salvation.—JAMES *Psychology*, vol. i, ch. 10, p. 314. (H. H. & Co., 1899.)

2942. SACRIFICE OF LOWER ORGANISM FOR HIGHER—*Inoculation of Animals to Protect Man.*—It may be necessary to observe the action of supposed pathogenic organisms upon animals. This is obviously a last resource, and any abuse of such a process is strictly limited by law. As a matter of fact, an immense amount of bacteriological investigation can be carried on without inoculating animals; but, strictly speaking, as regards many of the pathogenic bacteria this test is the most reliable of all. Nor would any responsible bacteriologist be justified in certifying a water as healthy for consumption by a large community if he was in doubt as to the disease-producing action of certain contained organisms.—NEWMAN *Bacteria*, ch. 2, p. 46. (G. P. P., 1899.)

2943. SACRIFICES TO MALEVOLENCE—*Terror the Inspiration to Worship of Serpents.*—The worship of serpents has been attributed to conceptions of a very abstract character—with the circle, for example, into which they coil themselves considered as an emblem of eternity. But this is a conception far too transcendental and far-fetched to account either for the origin of this worship or for its wide extension in the world. Serpents are not the only natural objects which present circular forms. . . . They have been chosen, beyond any reasonable doubt, because of the horror and terror they inspire. For this, above all other creatures, they are prominent in Nature. For their deceptive coloring, for their insidious approach, for their deadly virus, they have been taken as the type of spiritual poison in the Jewish narrative of the Fall. The power of inflicting almost immediate death, which is possessed by the most venomous snakes, and that not by violence, but by the infliction of a wound which in itself may be hardly visible, is a power which is indeed full of mystery even to the most cultivated scientific mind, and may well have inspired among men in early ages a desire to pacify the powers of evil. The moment this becomes the great aim and end of worship a principle is established which is fertile in the development of every foul imagination. Whenever it is the absorbing motive and desire of men to do that which may most gratify or pacify malevolence, then it ceases to be at all wonderful that men should be driven by their religion to sacrifices the most horrid, and to practises the most unnatural.—ARGYLL *Unity of Nature*, ch. 12, p. 290. (Burt.)

2944. SAGACITY, ANIMAL—*Mule Drinking from Cactus.*—The mule, more cautious and cunning, adopts another method of allaying his thirst [on the plains of South America]. There is a globular and articulated plant, the *Melocactus*, which encloses under its prickly integument an aqueous pulp. After carefully striking away the prickles with his forefeet the mule cautiously ventures to apply his lips to imbibe the cooling thistle juice. But the draft from this living vegetable spring is not always

unattended by danger, and these animals are often observed to have been lamed by the puncture of the cactus thorn.—HUMBOLDT *Views of Nature*, p. 15. (Bell, 1896.)

2945. SAGACITY OF A WASP—*Cutting Bulky Prey into Manageable Parcels.*—Dr. Erasmus Darwin records an observation ("Zoonomia," i, p. 183) which, from having since been so widely quoted, deserves to be called classical. He saw a wasp upon the ground endeavoring to remove a large fly which was too heavy for it to carry off. The wasp cut off the head and abdomen, and flew away with the thorax alone. The wind, however, catching the wings of this portion made it still too unwieldy for the wasp to guide. It therefore again alighted and nipped off first one wing and then the other, when it was able to fly off with its booty without further difficulty. This observation has since been amply confirmed.—ROMANES *Animal Intelligence*, ch. 4, p. 195. (A., 1899.)

2946. SAGACITY OF ESKIMO DOGS—*The Pack Scattering When on Thin Ice, to Distribute Their Weight.*—It will be remembered in connection with these dogs that Mr. Darwin in the "Descent of Man" (p. 75) quotes Dr. Hayes, who, in his work on "The Open Polar Sea," "repeatedly remarks that his dogs, instead of continuing to draw the sledges in a compact body, diverged and separated when they came to thin ice, so that their weight might be more evenly [and widely] distributed. This was often the first warning which the travelers received that the ice was becoming thin and dangerous." Mr. Darwin remarks: "This instinct may possibly have arisen since the time, long ago, when dogs were first employed by the natives in drawing their sledges; or the Arctic wolves, the parent stock of the Eskimo dog, may have acquired an instinct impelling them not to attack their prey in a close pack when on thin ice."—ROMANES *Animal Intelligence*, ch. 16, p. 462. (A., 1899.)

2947. SAGACITY SURPASSES THEORY—*Regelation of Ice and Snow.*—Two fragments of ordinary table ice brought carefully together freeze and cement themselves at their place of junction: or if two pieces floating in water be brought together, they instantly freeze, and by laying hold of either of them gently you can drag the other after it through the water. Imagine such points of attachment distributed in great numbers through a mass of snow. The substance becomes thereby a semisolid instead of a mass of powder. My guide, however, unaided by any theory, did a thing from which I should have shrunk, tho backed by all the theories in the world [viz., tramping Alpine snow into a firm support].—TYNDALL *Hours of Exercise in the Alps*, ch. 9, p. 100. (A., 1898.)

2948. SALT A NECESSITY OF LIFE—Common salt . . . is an article of food, tho often miscalled a condiment. Salt is food simply because it supplies the blood with one of its normal and necessary constituents, chlorid of sodium, without which we cannot live. A certain quantity of it exists in most of our ordinary food, but not always sufficient.—WILLIAMS *Chemistry of Cookery*, ch. 15, p. 259. (A., 1900.)

2949. SALVATION AN ACTIVE, EFFECTIVE PRINCIPLE—*The Definitive Overcoming of the Law of Deterioration and Death.*—There is a natural principle in man, lowering him, deadening him, pulling him down by inches to the mere animal plane, blinding reason, searing conscience, paralyzing will. This is the active destroying principle, or sin. Now to counteract this God has discovered to us another principle which will stop this drifting process in the soul, steer it round, and make it drift the other way. This is the active saving principle, or salvation. To neglect it is to cut off the only possible chance of escape. In declining this he is simply abandoning himself with his eyes open to that other and terrible energy which is already there, and which, in the natural course of things, is bearing him every moment further and further from escape.—DRUMMOND *Natural Law in the Spiritual World*, essay 2, p. 96. (H. Al.)

2950. SAND A PRESERVER OF ANCIENT MONUMENTS—No mode of interment can be conceived more favorable to the conservation of monuments for indefinite periods than that now so common in the region immediately westward of the Nile. The sand which surrounded and filled the great temple of Ipsambul, first discovered by Burckhardt, and afterwards partially uncovered by Belzoni and Beechey, was so fine as to resemble a fluid when put in motion. Neither the features of the colossal figures, nor the color of the stucco with which some were covered, nor the paintings on the walls, had received any injury from being enveloped for ages in this dry impalpable dust.—LYELL *Principles of Geology*, ch. 45, p. 726. (A., 1854.)

2951. SAND-BAR SHIFTED BY STORM—It sometimes happens that during a violent storm a large bar of sand is suddenly made to shift its position, so as to prevent the free influx of the tides, or efflux of river water. Thus about the year 1500 the sands at Bayonne were suddenly thrown across the mouth of the Adour. That river, flowing back upon itself, soon forced a passage to the northward along the sandy plain of Capbreton till at last it reached the sea at Boucau, at the distance of seven leagues from the point where it had formerly entered. It was not till the year 1579 that the celebrated architect Louis de Foix undertook, at the desire of Henry III., to reopen the ancient channel, which he at last

effected with great difficulty.—LYELL *Principles of Geology*, bk. ii, ch. 21, p. 338. (A., 1854.)

2952. SAVAGE COMPARED WITH BRUTE—*Reasoning Power Divides Man from Lower Animals.*—A creature which has few instinctive impulses, or interests, practical or esthetic, will dissociate few characters, and will, at best, have limited reasoning powers; whilst one whose interests are very varied will reason much better. Man, by his immensely varied instincts, practical wants, and esthetic feelings, to which every sense contributes, would, by dint of these alone, be sure to dissociate vastly more characters than any other animal; and accordingly we find that the lowest savages reason incomparably better than the highest brutes.—JAMES *Psychology*, vol. ii, ch. 22, p. 345. (H. H. & Co., 1890.)

2953. SAVAGE, HOW NATURE MOVES THE—*The Struggle for Life Develops New and Higher Powers.*—Start with a comparatively unevolved savage, and see what the struggle for life will do for him. When we meet him first he is sitting, we shall suppose, in the sun. Let us also suppose—and it requires no imagination to suppose it—that he has no wish to do anything else than sit in the sun, and that he is perfectly contented, and perfectly happy. Nature around him, visible and invisible, is as still as he is, as inert apparently, as unconcerned. Neither molests the other; they have no connection with each other. Yet it is not so. That savage is the victim of a conspiracy. Nature has designs upon him, wants to do something to him. That something is to move him. Why does it wish to move him? Because movement is work, and work is exercise, and exercise may mean a further evolution of the part of him that is exercised. How does it set about moving him? By moving itself. Everything else being in motion, it is impossible for him to resist. The sun moves away to the west and he must move or freeze with cold. As the sun continues to move, twilight falls and wild animals move from their lairs, and he must move or be eaten. The food he ate in the morning has dissolved and moved away to nourish the cells of his body, and more food must soon be moved to take its place or he must starve. So he starts up, he works, he seeks food, shelter, safety; and those movements make marks in his body, brace muscles, stimulate nerves, quicken intelligence, create habits, and he becomes more able and more willing to repeat these movements and so becomes a stronger and a higher man.—DRUMMOND *Ascent of Man*, ch. 6, p. 191. (J. P., 1900.)

2954. SAVAGE SURPASSES BRUTE—*Capacity for Language, Learning, Progress.*—In the comparison of man with other animals the standard should naturally be the lowest man, or savage. But the savage is possessed of human reason and speech, while his brain-power, tho it has not of itself raised him to civilization, enables him to receive more or less of the education which transforms him into a civilized man. To show how man may have advanced from savagery to civilization is a reasonable task. . . . But there is no such evidence available for crossing the mental gulf that divides the lowest savage from the highest ape. On the whole, the safest conclusion warranted by facts is that the mental machinery of the lower animals is roughly similar to our own, up to a limit. Beyond this limit the human mind opens out into wide ranges of thought and feeling which the beast-mind shows no sign of approaching. If we consider man's course of life from birth to death, we see that it is, so to speak, founded on functions which he has in common with lower beings. Man, endowed with instinct and capable of learning by experience, drawn by pleasure and driven by pain, must, like a beast, maintain his life by food and sleep, must save himself by flight, or fight it out with his foes, must propagate his species and care for the next generation. Upon this lower framework of animal life is raised the wondrous edifice of human language, science, art, and law.—TYLOR *Anthropology*, ch. 2, p. 54. (A., 1899.)

2955. SAVAGERY AS MODERN AS CIVILIZATION—*The Same Distance from Primeval Life.*—It is to be remembered that the savage of the present day is as far removed in time from the common origin of our race as the man who now exhibits the highest type of moral and intellectual culture. Whether that time is represented by six thousand, or ten thousand, or a hundred thousand years, it is the same for both. If, therefore, the number of years since the origin of man be taken as a multiplier in the processes of elevation, it must be taken equally as a multiplier in the processes of degradation. Not even on the theory which some hold, that the human species has spread from more than one center of birth or of creation, can this conclusion be affected. For even on this hypothesis of separate origins there is no reason whatever to suppose that the races which are now generally civilized are of more recent origin than those which are generally savage. Presumably, therefore, all the ages which have been at work in the development of civilization have been at work equally in the development of savagery. It is not possible in the case of savagery, any more than in the case of civilization, that all those ages have been without effect. Nor is it possible that the changes they have wrought have been all in one direction. The conclusion is, that neither savagery nor civilization, as we now see them, can represent the primeval condition of man. Both of them

are the work of time. Both of them are the product of evolution.—ARGYLL *Unity of Nature*, ch. 10, p. 232. (Burt.)

2956. SAVAGES AMIDST CIVILIZATION—Out of 164,000 persons committed to prison in England and Wales, only 4,000 could read and write well. In fact, our criminal population are mere savages, and most of their crimes are but injudicious and desperate attempts to live as a savage in the midst and at the expense of a civilized community.—AVEBURY *Prehistoric Times*, ch. 16, p. 574. (A., 1900.)

2957. SAVAGES DISTORT FACTS OF RECENT EVENTS—Even as regards events which are contemporary, or nearly so, we find that the accounts given by savages become rapidly distorted. Thus Nilsson quotes the account given by Mackenzie that the Eskimos described the English to him as being giants, with wings, who could kill with a glance of their eye, and swallow a whole beaver at a mouthful.—AVEBURY *Prehistoric Times*, ch. 13, p. 405. (A., 1900.)

2958. SAVAGES, DOMESTIC LIFE OF—*Oppression of Woman Not Universal.*—Cruelty does not breed refinement either of manners or of taste. Where women adorn themselves with flowers, and produce with skilful fingers work that will excite the admiration of the most refined, their home can hardly be the abode of cruelty. Of one of the most primitive peoples E. H. Man says: "It is incorrect to say that among the Andamanese marriage is nothing more than taking a female slave, for one of the striking features of their social relation is the marked equality and affection which subsists between husband and wife. Careful observations extended over many years prove that not only is the husband's authority more or less nominal, but that it is not at all an uncommon occurrence for Andamanese benedicts to be considerably at the beck and call of their better halves."—MASON *Woman's Share in Primitive Culture*, int., p. 7. (A., 1894.)

2959. SCAFFOLDING OF SCIENCE—*Dry Bones of Detail—Astronomy in Itself Interesting and Practical.*—Far from being a difficult and inaccessible science, astronomy is the science which concerns us most, the one most necessary for our general instruction, and at the same time the one which offers for our study the greatest charms and keeps in reserve the highest enjoyments. We cannot be indifferent to it, for it alone teaches us where we are and what we are; and, moreover, it need not bristle with figures, as some severe savants would wish us to believe. The algebraical formulæ are merely scaffoldings analogous to those which are used to construct an admirably designed palace. The figures drop off, and the palace of Urania shines in the azure, displaying to our wondering eyes all its grandeur and all its magnificence.—FLAMMARION *Popular Astronomy*, bk. i, ch. 1, p. 1. (A.)

2960. SCALES USED BY PRIMITIVE MAN—The scale or balance was known in America before the discovery. The Peruvians made beams of bone, suspended little nets to each end, supported the beam at the middle by means of a cord, and used stones for weights. The transition from the balance to the "steelyard" is not easy to make out.—MASON *Origins of Invention*, ch. 2, p. 68. (S., 1899.)

2961. SCAVENGERS, INSECTS AS—*The "Driver Ants" Help to Purify Tropical Lands—Invasion of Human Dwellings.*—Savage . . . has given a graphic account of the driver ants *(Anomma arcens)* of West Africa. They keep down, he says, "the more rapid increase of noxious insects and smaller reptiles; consume much dead animal matter, which is constantly occurring, decaying, becoming offensive, and thus vitiating the atmosphere, and which is by no means the least important in the torrid zone, often compelling the inhabitants to keep their dwellings, towns, and their vicinity in a state of comparative cleanliness. The dread of them is upon every living thing. . . .

"Their entrance into a house is soon known by the simultaneous and universal movement of rats, mice, lizards, *Blapsidæ*, *Blattidæ*, and of the numerous vermin that infest our dwellings. . . .

"They move over the house with a good degree of order, unless disturbed, occasionally spreading abroad, ransacking one point after another, till, either having found something desirable, they collect upon it, when they may be destroyed *en masse* by hot water. . . .

"When they are fairly in, we give up the house, and try to await with patience their pleasure, thankful, indeed, if permitted to remain within the narrow limits of our beds or chairs."

These ants will soon destroy even the largest animal if it is confined. In one case Savage saw them kill near his house a snake four feet long.—AVEBURY *Ants, Bees, and Wasps*, ch. 4, p. 63. (A., 1900.)

2962. SCAVENGERS OF THE SEA—*Service Rendered by Gulls—Ocean Transformed by Their Life and Beauty.*—The herring gull . . . is the gull we see in such numbers in our bays and harbors, flying gracefully and apparently aimlessly about, but in reality ever keeping its bright black eyes fixed on the water in search of some floating morsel, which it deftly picks from the surface. It frequently follows vessels, hanging over the stern day after day, and deserting its post only to feed on scraps thrown overboard from the galley. . . . Gulls do excellent service in devouring much refuse that would otherwise be cast ashore to decay; but, useful as they are as scaven-

gers, I feel that their place in Nature is to animate the barren wastes of the sea. How, when at sea, the presence of a single gull changes the whole aspect of Nature! The great expanse of water, which before was oppressive in its dreary lifelessness, is transformed by the white-winged gulls into a scene of rare beauty. Every voyager, be he naturalist or not, admires their grace of form and motion. They seem born of the waves, and as much a part of the ocean as the foamy whitecaps themselves.—CHAPMAN *Bird-Life*, ch. 7, p. 88. (A., 1900.)

2963. SCIENCE ACCEPTS POPULAR BELIEF—*Rhea's Stomach an Ancient Remedy—Now Valued for Pepsin.*—More than two centuries ago (very ancient times for South America) the gauchos were accustomed to take the lining of the rhea's stomach, dried and powdered, for ailments caused by impaired digestion, and the remedy is popular still. Science has gone over to them, and the ostrich-hunter now makes a double profit, one from the feathers, and the other from the dried stomachs which he supplies to the chemists of Buenos Ayres. Yet he was formerly told that to take the stomach of the ostrich to improve his digestion was as wild an idea as it would be to swallow birds' feathers in order to fly.—HUDSON *Naturalist in La Plata*, ch. 4, p. 79. (C. & H., 1895.)

2964. SCIENCE ADDS GLORY TO THE VISION OF REDEMPTION—I do not enter at all into the positive evidence for the truth of the Christian revelation, my single aim at present being to dispose of one of the objections which is conceived to stand in the way of it. Let me suppose, then, that this is done to the satisfaction of a philosophical inquirer, and that the evidence is sustained; and that the same mind that is familiarized to all the sublimities of natural science, and has been in the habit of contemplating God in association with all the magnificence which is around him, shall be brought to submit its thoughts to the captivity of the doctrine of Christ. Oh! with what veneration, and gratitude, and wonder should he look on the descent of Him into this lower world who made all these things, and without whom was not anything made that was made. What a grandeur does it throw over every step in the redemption of a fallen world, to think of its being done by Him who unrobed him of the glories of so wide a monarchy, and came to this humblest of its provinces, in the disguise of a servant, and took upon him the form of our degraded species, and let himself down to sorrows, and to sufferings, and to death, for us! In this love of an expiring Savior to those for whom in agony he poured out his soul there is a height, and a depth, and a length, and a breadth, more than I can comprehend; and let me never from this moment neglect so great a salvation, or lose my hold of an atonement, made sure by Him who cried that it was finished, and brought in an everlasting righteousness.—CHALMERS *Astronomical Discourses*, disc. 3, p. 85. (R. Ct., 1848.)

2965. SCIENCE ADVANCED BY ARABS IN SPITE OF HINDRANCES—Alchemy, magic, and mystic fancies, deprived by scholastic phraseology of all poetic charm, corrupted here, as elsewhere, in the Middle Ages, the true results of inquiry; but still the Arabs have enlarged the views of Nature, and given origin to many new elements of knowledge, by their indefatigable and independent labors, while, by means of careful translations into their own tongue, they have appropriated to themselves the fruits of the labors of earlier cultivated generations. Attention has been justly drawn to the great difference existing in the relations of civilization between immigrating Germanic and Arabian races. The former became cultivated after their immigration; the latter brought with them from their native country not only their religion, but a highly polished language, and the graceful blossoms of a poetry which has not been wholly devoid of influence on the Provençals and Minnesingers.—HUMBOLDT *Cosmos*, vol. ii, pt. ii, p. 212. (H., 1897.)

2966. SCIENCE, A HIGHER, NOT TO BE MERGED IN A LOWER—*Chemistry—Mechanics—Physiology—Terms of the Lower Misrepresent the Higher.*—"Any attempt to merge the distinctive characteristic of a higher science in a lower—of chemical changes in mechanical; of physiological in chemical; above all, of mental changes in physiological—is a neglect of the radical assumption of all science, because it is an attempt to deduce representations—or rather misrepresentations—of one kind of phenomenon from a conception of another kind which does not contain it, and must have it implicitly and illicitly smuggled in before it can be extracted out of it. Hence, instead of increasing our means of representing the universe to ourselves without the detailed examination of particulars, such a procedure leads to misconstructions of fact on the basis of an imported theory, and generally ends in forcibly perverting the least known science to the type of the better known."—DRUMMOND *Natural Law in the Spiritual World*, int., p. 19. (H. Al.)

2967. SCIENCE A LIVING REALITY—*To Know the Actual Earth and the Starry Heavens—Carlyle's Lament.*—Think of true science as a living reality; as a faithful expounder of all that is worth knowing and that can be known; as an existing power, ever anxious in its unwearied march for the good and welfare of mankind; and best of all, perhaps, as an ever-willing instructor of all who will come to be taught. . . . Let us bend the educational twig in its early growth that our ef-

forts may be perceptible on the fully grown tree. Let us send our boys and girls out into the world, knowing something of the world, of its wonders and of themselves, as well as of the proprieties of life, or of the dead languages and modern tongues. I think Carlyle well expresses himself regarding the want of such information when he says: "For many years it has been one of my constant regrets that no schoolmaster of mine had a knowledge of natural history—so far, at least, as to have taught me the grasses that grow by the wayside, and the little winged or wingless neighbors that are continually meeting me with a salutation that I cannot answer as things are. Why," he continues, "did not somebody teach me the constellations, and make me at home in the starry heavens which are always overhead, and which I don't half know to this day?"—ANDREW WILSON *Science-Culture for the Masses*, p. 30. (A., 1888.)

2968. SCIENCE AND PHILOSOPHY—*Each Needs Help from the Other.*—If we consider and compare the most important advances which the human mind has made in the knowledge of truth, we shall soon see that it is always owing to philosophical mental operations that these advances have been made, and that the experience of the senses which certainly and necessarily precedes these operations, and the knowledge of details gained thereby, only furnish the basis for those general laws. Experience and philosophy, therefore, by no means stand in such exclusive opposition to each other as most men have hitherto supposed; they rather necessarily supplement each other. The philosopher who is wanting in the firm foundation of sensuous experience, of empirical knowledge, is very apt to arrive at false conclusions in his general speculations, which even a moderately informed naturalist can refute at once. On the other hand, the purely empiric naturalists, who do not trouble themselves about the philosophical comprehension of their sensuous experiences and who do not strive after general knowledge, can promote science only in a very slight degree, and the chief value of their hard-won knowledge of details lies in the general results which more comprehensive minds will one day derive from them.—HAECKEL *History of Creation*, vol. i, ch. 4, p. 81. (K. P. & Co., 1899.)

2969. SCIENCE AND THE SCHOOLMEN—*The Abdication of Galileo.*—The early part of the seventeenth century, when Descartes reached manhood, is one of the great epochs of the intellectual life of mankind. At that time, physical science suddenly strode into the arena of public and familiar thought, and openly challenged, not only philosophy and the church, but that common ignorance which passes by the name of common sense. The assertion of the motion of the earth was a defiance to all three, and physical science threw down her glove by the hand of Galileo. It is not pleasant to think of the immediate result of the combat; to see the champion of science, old, worn, and on his knees before the Cardinal Inquisitor, signing his name to what he knew to be a lie. . . . But two hundred years have passed, and however feeble or faulty her soldiers, physical science sits crowned and enthroned as one of the legitimate rulers of the world of thought. Charity children would be ashamed not to know that the earth moves; while the schoolmen are forgotten.—HUXLEY *Lay Sermons*, serm. 14, p. 330. (G. P. P., 1899.)

2970. SCIENCE, APPLIED—*Not a Special Branch, but Simply the Practical Use of All.*—Pasteur, one of the most eminent members of the Institute of France, in accounting for the disastrous overthrow of his country and the predominance of Germany in the late war, expresses himself thus: "Few persons comprehend the real origin of the marvels of industry and the wealth of nations. I need no further proof of this than the employment more and more frequent in official language, and in writing of all sorts, of the erroneous expression *applied science*. The abandonment of scientific careers by men capable of pursuing them with distinction was recently deplored in the presence of a minister of the greatest talent. The statesman endeavored to show that we ought not to be surprised at this result, because *in our day the reign of theoretic science yielded place to that of applied science*. Nothing could be more erroneous than this opinion, nothing, I venture to say, more dangerous, even to practical life, than the consequences which might flow from these words. They have rested in my mind as a proof of the imperious necessity of reform in our superior education. There exists no category of the sciences to which the name of 'applied' science could be rightly given. *We have science, and the applications of science*, which are united together as the tree and its fruit." [See PRACTISE.] —TYNDALL *Lectures on Light*, p. 223. (A., 1898.)

2971. SCIENCE A REST FROM STRIFE—*Man against Man.*—While on the steppe tigers and crocodiles contend with horses and cattle, so on the forest borders and in the wilds of Guiana the hand of man is ever raised against his fellow man. With revolting eagerness some tribes drink the flowing blood of their foes, whilst others, seemingly unarmed, yet prepared for murder, deal certain death with a poisoned thumb-nail. The feebler tribes, when they tread the sandy shores, carefully efface with their hands the traces of their trembling steps. Thus does man, everywhere alike, on the lowest scale of brutish debasement, and in the false glitter of his higher culture, perpetually create for himself a life of care. And thus, too, the traveler, wandering over

the wide world by sea and land, and the historian who searches the records of bygone ages, are everywhere met by the unvarying and melancholy spectacle of man opposed to man. He, therefore, who amid the discordant strife of nations, would seek intellectual repose, turns with delight to contemplate the silent life of plants, and to study the hidden forces of Nature in her sacred sanctuaries; or yielding to that inherent impulse, which for thousands of years has glowed in the breast of man, directs his mind by a mysterious presentiment of his destiny towards the celestial orbs, which, in undisturbed harmony, pursue their ancient and eternal course.—HUMBOLDT *Views of Nature*, p. 20. (Bell, 1896.)

2972. SCIENCE BEFORE INSTRUMENTS—*Discovery of Kepler's Laws Antedated the Telescope—Achievements of Tycho Brahe and Other Early Scientists.*—The basis of a very important part of the astronomy of our planetary system was already laid before the memorable years 1608 and 1610, and therefore before the great epoch of the invention of telescopic vision, and its application to astronomical purposes. The treasure transmitted by the learning of the Greeks and Arabs was augmented by the careful and persevering labors of George Purbach, Regiomontanus (*i. e.*, Johann Müller), and Bernhard Walther, of Nürnberg. To their efforts succeeded a bold and glorious development of thought—the Copernican system; this, again, was followed by the rich treasures derived from the exact observations of Tycho Brahe and the combined acumen and persevering spirit of calculation of Kepler. Two great men, Kepler and Galileo, occupy the most important turning-point in the history of measuring astronomy, both indicating the epoch that separates observation by the naked eye, tho aided by greatly improved instruments of measurement, from telescopic vision. Galileo was at that period forty-four, and Kepler thirty-seven years of age; Tycho Brahe, the most exact of the measuring astronomers of that great age, had been dead seven years. . . . None of Kepler's contemporaries, Galileo not excepted, bestowed any adequate praise on the discovery of the three laws which have immortalized his name. Discovered by purely empirical methods, altho more rich in results to the whole domain of science than the isolated discovery of unseen cosmical bodies, these laws belong entirely to the period of natural vision, to the epoch of Tycho Brahe and his observations, altho the printing of the work entitled "Astronomia nova seu Physica cœlestis de motibus Stellæ Martis" was not completed until 1609, and the third law, that the squares of the periodic times of revolution of two planets are as the cubes of their mean distances, was first fully developed in 1619.—HUMBOLDT *Cosmos*, vol. iii. p. 69. (H., 1897.)

2973. SCIENCE BROADENS OUR ESTIMATE OF THE UNIVERSE—*Leads to Modest Estimate of Ourselves (Ps. viii, 4).*—Did the discoveries of science stop here, we have enough to justify the exclamation of the psalmist, "What is man, that thou are mindful of him; or the son of man, that thou shouldest deign to visit him?" They widen the empire of creation far beyond the limits which were formerly assigned to it. They give us to see that yon sun, throned in the center of his planetary system, gives light, and warmth, and the vicissitude of seasons to an extent of surface several hundreds of times greater than that of the earth which we inhabit. They lay open to us a number of worlds, rolling in their respective circles around this vast luminary, and prove that the ball which we tread upon, with all its mighty burden of oceans and continents, instead of being distinguished from the others, is among the least of them, and, from some of the more distant planets, would not occupy a visible point in the concave of their firmament. They let us know that tho this mighty earth, with all its myriads of people, were to sink into annihilation, there are some worlds where an event so awful to us would be unnoticed and unknown, and others where it would be nothing more than the disappearance of a little star which had ceased from its twinkling. We should feel a sentiment of modesty at this just but humiliating representation. We should learn not to look on our earth as the universe of God, but one paltry and insignificant portion of it; that it is only one of the many mansions which the Supreme Being has created for the accommodation of his worshipers, and only one of the many worlds rolling in that flood of light which the sun pours around him to the outer limits of the planetary system.—CHALMERS *Astronomical Discourses*, p. 24. (R. Ct., 1848.)

2974. SCIENCE CANNOT DISPROVE THEOLOGY—*Redemption May Reach All the Worlds of Space.*—For anything he [the objector] can tell, sin has found its way into these other worlds. For anything he can tell, their people have banished themselves from communion with God. . . . For anything he can tell, the redemption proclaimed to us is not one solitary instance, or not the whole of that redemption which is by the Son of God, but only our part in a plan of mercy, equal in magnificence to all that astronomy has brought within the range of human contemplation. For anything he can tell, the moral pestilence, which walks abroad over the face of our world, may have spread its desolations over all the planets of all the systems which the telescope has made known to us. . . . For anything he can tell, the wonder-working God, who has strewed the field of immensity with so many worlds, and spread the shelter of his omnipotence over them, may have sent a message of love to each. . . . For anything

he can tell, angels from paradise may have sped to every planet their delegated way, and sung from each azure canopy a joyful annunciation, and said, "Peace be to this residence, and good-will to all its families, and glory to him in the highest, who, from the eminency of his throne, has issued an act of grace so magnificent as to carry the tidings of life and of acceptance to the unnumbered orbs of a sinful creation."—CHALMERS *Astronomical Discourses*, p. 58. (R. Ct., 1848.)

2975. SCIENCE CANNOT PROVE IMMORTALITY—*Types of Sound and Flame.*—As yet we know of no fact, which can be established by scientific observation, which would show that the finer and complex forms of vital motion could exist otherwise than in the dense material of organic life; that it can propagate itself as the sound-movement of a string can leave its originally narrow and fixed home and diffuse itself in the air, keeping all the time its pitch and the most delicate shade of its color-tint; and that, when it meets another string attuned to it, starts this again or excites a flame ready to sing to the same tone. The flame, even, which, of all processes in inanimate Nature, is the closest type of life, may become extinct, but the heat which it produces continues to exist—indestructible, imperishable, as an invisible motion, now agitating the molecules of ponderable matter, and then radiating into boundless space as the vibration of an ether. Even there it retains the characteristic peculiarities of its origin, and it reveals its history to the inquirer who questions it by the spectroscope. United afresh, these rays may ignite a new flame, and thus, as it were, acquire a new bodily existence.—HELMHOLTZ *Popular Lectures*, lect. 4, p. 194. (L. G. & Co., 1898.)

2976. SCIENCE CONFRONTED WITH MYSTERY—*Transition from Phenomena of Physics to Phenomena of Thought across a Gulf.*—When we endeavor to pass by a similar process from the phenomena of physics to those of thought we meet a problem which transcends any conceivable expansion of the powers which we now possess. We may think over the subject again and again, but it eludes all intellectual presentation. We stand at length face to face with the incomprehensible. The territory of physics is wide, but it has its limits from which we look with vacant gaze into the region beyond. Let us follow matter to its utmost bounds, let us claim it in all its forms—even in the muscles, blood, and brain of man himself—as ours to experiment with and to speculate upon. Casting the term "vital force" from our vocabulary, let us reduce, if we can, the visible phenomena of life to mechanical attractions and repulsions. Having thus exhausted physics and reached its very rim, a mighty mystery still looms beyond us. We have, in fact, made no step towards its solution.—TYNDALL *Fragments of Science*, vol. ii, ch. 15, p. 391. (A., 1900.)

2977. SCIENCE, CONQUESTS OF—*Arabs Not Fitted to Work Out Highest Results.*—As Wilhelm von Humboldt observes: "What would be the condition of our civilization at the present day if the Arabs had remained, as they long did, the sole possessors of scientific knowledge, and had spread themselves permanently over the west? A less favorable result would probably have supervened. . . . It is to the same causes which procured for the Romans a dominion over the world—the Roman spirit and character—and not to external and merely adventitious chances, that we owe the influence exercised by the Romans on our civil institutions, our laws, languages, and culture. It was owing to this beneficial influence and to the intimate alliance of races that we were rendered susceptible to the influence of the Greek mind and language, while the Arabs directed their consideration principally only to those scientific results of Greek investigation which referred to the description of Nature, and to physical, astronomical, and purely mathematical science." The Arabs, by carefully preserving the purity of their native tongue, and the delicacy of their figurative modes of expression, were enabled to impart the charm of poetic coloring to the expression of feeling and of the noble axioms of wisdom; but, to judge from what they were under the Abbassides, had they built on the same foundation with which we find them familiar it is scarcely probable that they could have produced those works of exalted poetic and creative art which, fused together in one harmonious accord, are the glorious fruits of the mature season of our European culture.—HUMBOLDT *Cosmos*, vol. ii, pt. ii, p. 227. (H., 1897.)

2978. SCIENCE DEMANDS A LIFE BEYOND THAT OF THE SENSES—*Pictorial Power Needed to Deal with Underlying Principles.*—The life of the experimental philosopher is twofold. He lives, in his vocation, a life of the senses, using his hands, eyes, and ears in his experiments; but such a question as that now before us [the ultimate nature of light] carries him beyond the margin of the senses. He cannot consider, much less answer, the question, "What is light?" without transporting himself to a world which underlies the sensible one, and out of which spring all optical phenomena. To realize this subsensible world, if I may use the term, the mind must possess a certain pictorial power.—TYNDALL *Lectures on Light*, lect. 2, p. 43. (A., 1898.)

2979. SCIENCE DEPENDENT ON ENVIRONMENT—Indeed, the experience acquired by its [the telescope of Lord Rosse] use plainly shows that atmospheric rather than mechanical difficulties impede a still further increase of telescopic power. Its

construction may accordingly be said to mark the *ne plus ultra* of effort in one direction, and the beginning of its conversion towards another. It became thenceforward more and more obvious that the conditions of observation must be ameliorated before any added efficacy could be given to it. The full effect of an uncertain climate in nullifying optical improvements was recognized, and the attention of astronomers began to be turned toward the advantages offered by more tranquil and more translucent skies.—CLERKE *History of Astronomy*, pt. i, ch. 6, p. 148. (Bl., 1893.)

2980. SCIENCE DESTROYING IDOLATRY—*Sun-worship Impossible—Mind Alone Adorable.*—Has not science, for example, even in these last few years, rendered forever impossible one of the oldest and most natural of the idolatries of the world? It has disclosed to us the physical constitution of the sun—that great heavenly body which is one of the chief proximate causes of all that we see and enjoy on earth, and which has seemed most naturally the very image of the Godhead to millions of the human race. We now know the sun to be simply a very large globe of solid and of gaseous matter, in a state of fierce and flaming incandescence. No man can worship a ball of fire, however big, nor can he feel grateful to it, nor love it, nor adore it, even tho its beams be to him the very light of life. Neither in it nor in the mere physical forces of which it is the center can we see anything approaching to the rank and dignity of even the humblest human heart. "What know we greater than the soul?" It is only when we come to think of the coordination and adjustment of these physical forces as part of the mechanism of the heavens—it is only, in short, when we recognize the mental . . . element, that the universe becomes glorious and intelligible, as indeed a cosmos—a system of order and beauty adapted to the various ends which we see actually attained, and to a thousand others which we can only guess.—ARGYLL *Unity of Nature*, ch. 8, p. 183. (Burt.)

2981. SCIENCE DOES NOT CONTROL ACTIVITIES—*Logic and Reasoning—Ethics and Conduct.*—The science of logic never made a man reason rightly, and the science of ethics (if there be such a thing) never made a man behave rightly. The most such sciences can do is to help us to catch ourselves up and check ourselves, if we start to reason or to behave wrongly, and to criticize ourselves more articulately after we have made mistakes. A science only lays down lines within which the rules of the art must fall, laws which the follower of the art must not transgress; but what particular thing he shall positively do within those lines is left exclusively to his own genius.—JAMES *Talks to Teachers*, ch. 1, p. 8. (H. H. & Co., 1900.)

2982. SCIENCE DOES NOT DISDAIN THE KITCHEN—*Meat Cooked at Lower Temperature.*—At Munich water boils at 209½° (on account of its elevation), while in London the boiling-point is 212°. "Yet nobody, I believe, ever perceived that boiled meat was less done at Munich than at London. But if meat may without the least difficulty be cooked with a heat of 209½° at Munich, why should it not be possible to cook it with the same degree of heat in London? If this can be done in London (which, I think, can hardly admit of a doubt), then it is evident that the process of cookery which is called boiling may be performed in water which is not boiling hot."—COUNT RUMFORD, quoted by WILLIAMS in *Chemistry of Cookery*, ch. 2, p. 16. (A. 1900.)

2983. SCIENCE, ECONOMIC VALUE OF—*Pasteur Saves Silk Culture of France.*—If also you will read the account . . . of Pasteur's researches into the nature and cause of the great silkworm disease, known as "pebrine," which decimates that insect species as cholera slays its human thousands, you will discover how a zoological study saved the commercial prosperity of France. Prior to Pasteur's researches the silkworms died in multitudes from the mysterious epidemic, and blank ruin stared the silk-growers and -cultivators in the face. When, however, by careful study of the causes and conditions of the disease, Pasteur had made himself master of the situation, and had found that a minute plant-organism, propagating itself within the bodies of the silkworms and readily conveyed from one to the other, was the cause of the disorder, his countrymen fully realized the truth of the proverb that "knowledge is power," and that to scientific research was due the salvation of their commerce and the rescue of their happiness and prosperity.—ANDREW WILSON *Science-Culture for the Masses*, p. 32. (Hum., 1888.)

2984. SCIENCE FAVORS SIMPLICITY—*Plain Language Required by Royal Society.*— It [the Royal Society in time of Charles II.] "exacted from all its members a close, naked, natural way of speaking, positive expressions, clear senses, a native easiness, bringing all things as near the mathematical plainness as they can, and preferring the language of artisans, countrymen, and merchants before that of wits or scholars." Thence sprang that requirement which enters into all highly developed modern systems of patent law, that a specification shall not be addressed to the erudite and learned, but shall be written in such full, clear, and exact terms that any person skilled in the art to which it nearest relates shall be able to understand it and put it in practise. In a word, the Royal Society completely revolutionized didactic and technical writing and the mode of expressing scientific thought, and thereby did enough, had it immediately afterwards gone out of

existence, to earn for itself the perpetual gratitude of mankind.—PARK BENJAMIN *Intellectual Rise in Electricity*, ch. 13, p. 412. (J. W., 1898.)

2985. SCIENCE FOUNDED ON FAITH—*Confidence in the Order of Nature—Man's Thought Sweeps All Space and All Time.*—It may perhaps appear rash that we —restricted as we are in the circle of our observations in space, by our position on this little earth, which is but as a grain of dust in our Milky Way, and limited in time by the short duration of the human race—that we should attempt to apply the laws which we have deduced from the confined circle of facts open to us to the whole range of infinite space, and of time from everlasting to everlasting. But all our thought and our action, in the greatest as well as in the least, is based on our confidence in the unchangeable order of Nature, and this confidence has hitherto been the more justified the deeper we have penetrated into the interconnections of natural phenomena. And that the general laws, which we have found, also hold for the most distant vistas of space, has acquired strong actual confirmation during the past half-century. — HELMHOLTZ *Popular Lectures*, lect. 4, p. 144. (L. G. & Co., 1898.)

2986. SCIENCE, FOUR PILLARS OF—*Nothing Proved Till "Foursquare to Opposition"—Crude and Hasty Inference Rebuked.*—Every completed scientific investigation must consist of four series of operations. In the first of these an attempt is made to collect the whole of the facts bearing on the question, by means of observation and experiment, the latter being only observation under conditions determined by ourselves. In the second stage of the inquiry the attention is directed to classifying and grouping the isolated facts, so as to determine their bearings upon one another and the general conclusions to which they appear to point. In the third stage it is sought to frame an hypothesis which shall embrace all the observed facts, and shall be in harmony with the general conclusions derived from them. In the fourth stage this hypothesis is put to the most rigid test, comparing the results which must follow, if it be true, with the phenomena actually observed, and rejecting or amending our hypothesis accordingly. Every great scientific theory has thus been established by these four processes—observation, generalization, hypothesis, and verification.—JUDD *Volcanoes*, ch. 12, p. 331. (A., 1899.)

2987. SCIENCE HAS ALWAYS NEW WORLDS TO CONQUER—As men contemplate the riches of Nature, and see the mass of observations incessantly increasing before them, they become impressed with the intimate conviction that the surface and the interior of the earth, the depths of the ocean, and the regions of air will still, when thousands and thousands of years have passed away, open to the scientific observer untrodden paths of discovery. The regret of Alexander cannot be applied to the progress of observation and intelligence.—HUMBOLDT *Cosmos*, vol. i, int., p. 41. (H., 1897.)

2988. SCIENCE INDEPENDENT OF PHILOSOPHICAL THEORIES—*Investigator Should Keep to His Own Department.*—Neither materialism nor spiritualism is a scientific term, and one need have no concern with them in a scientific inquiry which, if it be true to its spirit, is bound to have regard only to what lies within its powers and to the truth of its results. It would seem to be full time that vague and barren disputations concerning materialism and spiritualism should end, and that, instead of continuing such fruitless and unprofitable discussion, men should apply themselves diligently to discover, by direct interrogation of Nature, how much matter can do without spiritual help. Let each investigator pursue the method of research which most suits the bent of his genius, and here, as in other departments of science, let each system be judged by its fruits, which cannot fail in the end to be the best sponsors and sureties for its truth. — MAUDSLEY *Body and Mind*, pref., p. 6. (A., 1898.)

2989. SCIENCE IN ITS PRACTICAL BEARINGS—*The Material Triumphs of the Nineteenth Century.* — When our century, with justice, is called the age of natural science, when we look with pride upon the immensely important progress made in all its branches, we are generally in the habit of thinking more of immediate practical results, and less of the extension of our general knowledge of Nature. We call to mind the complete reform, so infinitely rich in consequences to human intercourse, which has been effected by the development of machinery, by railways, steamships, telegraphs, and other inventions of physics. Or we think of the enormous influence which chemistry has brought to bear upon medicine, agriculture, and upon all arts and trades.—HAECKEL *History of Creation*, vol. i, ch. 1, p. 2. (K. P. & Co., 1899.)

2990. SCIENCE IN PRESENCE OF THE OLD MYSTERY—*Infinite Purpose Associated with Endless Material Evolution.*—The wave of life which is now passing over our earth is but a ripple in the sea of life within the solar system; this sea of life is itself but as a wavelet on the ocean of eternal life throughout the universe. Inconceivable, doubtless, are these infinities of time and space, of matter, of motion, and of life. Inconceivable that the whole universe can be for all time the scene of the operation of infinite personal power, omnipresent, all-knowing! Utterly incomprehensible how infinite purpose can be associated with endless material evolution! But it is no new thought, no modern discovery, that we

are thus utterly powerless to conceive or comprehend the idea of an Infinite Being, almighty, all-knowing, omnipresent, and eternal, of whose inscrutable purpose the material universe is the unexplained manifestation. Science is in presence of the old, old mystery; the old, old questions are asked of her: "Canst thou by searching find out God? canst thou find out the Almighty unto perfection? It is as high as heaven; what canst thou do? deeper than hell; what canst thou know?" (Job xi, 7.) And science answers these questions as they were answered of old: "As touching the Almighty, we cannot find him out" (Job xxxvii, 23).—PROCTOR *Our Place among Infinities*, p. 34. (L. G. & Co., 1897.)

2991. SCIENCE, INSTRUCTION IN—*Progress of Germany through Scientific Education.*—If we investigate more closely the causes of the wonderful strides which Germany has made in all directions, we shall find that it is not due to the mystified and inexplicable ponderous phrases of their philosophers, nor to the beautiful and descriptive verses of their poets, nor yet to the system of federation and the great victories due to their statesmen and warriors. On the other hand, we will find that this progress is due directly to the system of instruction in science, which during the last hundred years has permeated all parts of the German Empire, dominating the faculties of its universities and absorbing all the energies of its technical schools. And among the sciences whose teachings have made this great progress possible chemistry easily stands at the head.

Directly springing from the instruction given in the universities and technical schools have grown the great industries which have pushed the German people to the forefront in many of the leading pursuits of civilized life.—WILEY *Relations of Chemistry to Industrial Progress (Address at Purdue University, Lafayette, Ind., 1896*, p. 16).

2992. SCIENCE IS EXACT, SYSTEMATIZED KNOWLEDGE—*Material for Science Gained Even by Savages.*—Science is exact, regular, arranged knowledge. Of common knowledge savages and barbarians have a vast deal, indeed the struggle of life could not be carried on without it. The rude man knows much of the properties of matter, how fire burns and water soaks, the heavy sinks and the light floats, what stone will serve for the hatchet and what wood for its handle, which plants are food and which are poison, what are the habits of the animals that he hunts or that may fall upon him. He has notions how to cure, and much better notions how to kill. In a rude way he is a physicist in making fire, a chemist in cooking, a surgeon in binding up wounds, a geographer in knowing his rivers and mountains, a mathematician in counting on his fingers. All this is knowledge, and it was on these foundations that science proper began to be built up, when the art of writing had come in and society had entered on the civilized stage.—TYLOR *Anthropology*, ch. 13, p. 309. (A., 1899.)

2993. SCIENCE JUSTIFIES PRACTICAL SAGACITY—*Solidification of Alpine Snow.*—Upon the wall of rock was placed a second wall of snow, which dwindled to a pure knife-edge at the top. It was white, of very fine grain, and a little moist. How to pass this snow catenary I knew not, for I did not think a human foot could trust itself upon so frail a support. Bennen's practical sagacity, however, came into play. He tried the snow by squeezing it with his foot, and to my astonishment began to cross it. Even after the pressure of his feet the space he had to stand on did not exceed a handbreadth. I followed him, exactly as a boy walking along a horizontal pole, with toes turned outwards. Right and left the precipices were appalling. We reached the opposite rock, and an earnest smile rippled over Bennen's countenance as he turned towards me. He knew that he had done a daring thing, tho not a presumptuous one. "Had the snow," he said, "been less perfect, I should not have thought of attempting it; but I knew after I had set my foot upon the ridge that we might pass without fear."

It is quite surprising what a number of things the simple observation made by Faraday in 1846 [see REGELATION] enables us to explain. Bennen's instinctive act is justified by theory. The snow was fine in grain, pure, and moist. When pressed, the attachments of its granules were innumerable, and their perfect cleanness enabled them to freeze together with a maximum energy. It was this freezing which gave the mass its sustaining power.—TYNDALL *Hours of Exercise in the Alps*, ch. 9, p. 99. (A., 1898.)

2994. SCIENCE, MODERN, IS PRACTICAL—*Bacteriology Studies Prevention of Disease—Life-and-Death Battles under the Microscope.*—The object of modern bacteriology is not merely to accumulate tested facts of knowledge, nor only to learn the truth respecting the biology and life-history of bacteria. These are most important things from a scientific point of view. But they are also a means to an end; that end is the prevention of preventable diseases and the treatment of any departure from health. In a science not a quarter of a century old much has already been accomplished in this direction. The knowledge acquired of, and the secrets learned from, these tiny vegetable cells, which have such potentiality for good or evil, have been, in some degree, turned against them. When we know what favors their growth and vitality and virulence, we know something of the physical conditions which are inimical to their life; when we know how to grow them, we also know how to kill them.—NEWMAN *Bacteria*, ch. 9, p. 322. (G. P. P., 1899.)

2995. SCIENCE, NATURAL, THE LIMITS OF—Physics, as the name itself implies, can only deduce the phenomena of the physical world from the properties of matter: the highest aim of experimental science is therefore to ascend to the existence of the laws, and progressively to generalize the same. Whatever lies beyond is no object for physical demonstration, it belongs to another order of more elevated speculations. Immanuel Kant, one of the few philosophers whom no one has yet accused of impiety, has, with rare sagacity, indicated the limits of physical explanation in his renowned "Essai sur la Théorie et la Construction des Cieux," Koenigsberg, 1775.—HUMBOLDT *Preface to French translation of the Cosmos.* (Translated for *Scientific Side-Lights.)*

2996. SCIENCE NEITHER PROVES NOR DENIES A GOD—*The Inconceivable May Still Be Fact—The Realities of Science Point to Infinite Purpose.*—So far as science is concerned, the idea of a personal God is inconceivable, as are all the attributes which religion recognizes in such a being. On the other hand, it should be admitted as distinctly, that science no more disproves the existence of infinite personal power or wisdom than she disproves the existence of infinite material energy (which on the contrary must be regarded as probable), or the existence of infinite space or time (which must be regarded as certain). . . . To the man of science, observing the operation of second causes in every process with which his researches deal, and finding no limit to the operation of such causes, however far back he may trace the chain of causation, the idea of a first cause is as inconceivable in its relation to observed scientific facts as is the idea of infinite space in its relation to the finite space to which the observations of science extend. Yet infinite space must be admitted; nor do I see how even that man of science who would limit his thoughts most rigidly to facts can admit that all things are of which he thinks, without having impressed upon him the feeling that, in some way he cannot understand, these things represent the operation of infinite purpose.—PROCTOR *Our Place among Infinities,* p. 2. (L. G. & Co., 1897.)

2997. SCIENCE NOT A REVELATION OF SPIRITUAL TRUTH—*No Moral Telescope to Make Discoveries in the Spiritual Realm.*—Without the testimony of an authentic messenger from heaven, I know nothing of heaven's counsels. I never heard of any moral telescope that can bring to my observation the doings or the deliberations which are taking place in the sanctuary of the Eternal. I may put into the registers of my belief all that comes home to me through the senses of the outer man, or by the consciousness of the inner man. But neither the one nor the other can tell me of the purposes of God; can tell me of the transactions or the designs of his sublime monarchy; can tell me of the goings forth of Him who is from everlasting unto everlasting; can tell me of the march and the movements of that great administration which embraces all worlds, and takes into its wide and comprehensive survey the mighty roll of innumerable ages. . . . The more that this spirit [the modesty of true science] is cultivated and understood, the more will it be found in alliance with that spirit, in virtue of which all that exalteth itself against the knowledge of God is humbled, and all lofty imaginations are cast down, and every thought of the heart is brought into the captivity of the obedience of Christ.—CHALMERS *Astronomical Discourses,* disc. 2, p. 65. (R. Ct., 1848.)

2998. SCIENCE NOT TO BE ESTIMATED BY MERE UTILITY—There is no science whose value can be adequately estimated by economists and utilitarians of the lower order. Its true quantities cannot be represented by arithmetical figures or monetary tables; for its effects on mind must be as surely taken into account as its operations on matter, and what it has accomplished for the human intellect as certainly as what it has done for the comforts of society or the interests of commerce. Who can attach a marketable value to the discoveries of Newton?—MILLER *Old Red Sandstone,* ch. 10, p. 177. (G. & L., 1851.)

2999. SCIENCE OF NATURE—*A Universal System.*—This, then, is what is designed to be conveyed by the "foundation of astronomical or cosmical physics." It means the establishment of a science of Nature whose conclusions are not only presumed by analogy, but are ascertained by observation, to be valid wherever light can travel and gravity is obeyed—a science by which the nature of the stars can be studied upon the earth, and the nature of the earth can be made better known by study of the stars—a science, in a word, which is, or aims at being, one and universal, even as Nature—the visible reflection of the invisible highest Unity—is one and universal.—CLERKE *History of Astronomy,* pt. ii, ch. 1, p. 176. (Bl., 1893.)

3000. SCIENCE OF POLITICS—*Knowledge of Social Laws Still Rudimentary.*—The world is not so prosperous or so happy as that we should readily or willingly believe in the exhaustion of the means which are at our disposal for its better guidance. Especially in the great science of politics, which investigates the complicated forces whose action and reaction determine the condition of organized societies of men, we are still standing, as it were, only at the break of day. Our command over the external elements of Nature is, beyond all comparison, in advance of our command over the resources of human character.—ARGYLL *Reign of Law,* ch. 7, p. 228. (Burt.)

3001. SCIENCE OVERCOMES DIFFICULTIES — *Color-photography.* — It has long been the dream of photographers to discover some mode of obtaining pictures which shall reproduce all the colors of Nature without the intervention of the artist's manipulation. This was seen to be exceedingly difficult, if not impossible, because the chemical action of colored light has no power to produce pigments of the same color as the light itself, without which a photograph in natural colors would seem to be impossible. Nevertheless, the problem has been solved, but in a totally different manner; that is, by the principle of "interference," instead of by that of chemical action. This principle was discovered by Newton, and is exemplified in the colors of the soap-bubble, and in those of mother-of-pearl and other iridescent objects. It depends on the fact that the differently colored rays are of different wave-lengths, and the waves reflected from two surfaces half a wave-length apart neutralize each other and leave the remainder of the light colored. If, therefore, each differently colored ray of light can be made to produce a corresponding minute wave-structure in a photographic film, then each part of the film will reflect only light of that particular wave-length, and therefore of that particular color, that produced it. This has actually been done by Professor Lippmann, of Paris, who published his method in 1891; and in a lecture before the Royal Society in April, 1896, he fully described it and exhibited many beautiful specimens.—WALLACE *The Wonderful Century,* ch. 5, p. 36. (D. M. & Co., 1899.)

3002. SCIENCE PERSONIFIES FORCES—*Laws Invested with Attributes of Mind.* —The universal prevalence of this idea of purpose in Nature is indicated by the irresistible tendency which we observe in the language of science to personify the forces, and the combinations of force by which all natural phenomena are produced. It is a great injustice to scientific men—too often committed—to suspect them of unwillingness to accept the idea of a personal Creator merely because they try to keep separate the language of science from the language of theology. But it is curious to observe how this endeavor constantly breaks down—how impossible it is in describing physical phenomena to avoid the phraseology which identifies them with the phenomena of mind, and is molded on our own conscious personality and will. It is impossible to avoid this language simply because no other language conveys the impression which innumerable structures leave upon the mind. Take, for example, the word "contrivance." How could science do without it? How could the great subject of animal mechanics be dealt with scientifically without continual reference to law as that by which, and through which, special organs are formed for the doing of special work? What is the very definition of a machine? Machines do not increase force, they only adjust it. The very idea and essence of a machine is that it is a contrivance for the distribution of force with a view to its bearing on special purposes. A man's arm is a machine in which the law of leverage is supplied to the vital force for the purposes of prehension. . . . Anatomy supplies an infinite number of similar examples. It is impossible to describe or explain the facts we meet with in this or in any other branch of science without investing the "laws" of Nature with something of that personality which they do actually reflect, or without conceiving of them as partaking of those attributes of mind which we everywhere recognize in their working and results.—ARGYLL *Reign of Law,* ch. 2, p. 54. (Burt.)

3003. SCIENCE, PHYSICAL VS. MENTAL—*Individuality of Consciousness.*—The phenomena of the external world are so palpable and so easily described that the experience of one observer suffices to render the facts he has witnessed intelligible and probable to all. The phenomena of the internal world, on the contrary, are not capable of being thus described; all that the prior observer can do is to enable others to repeat his experience. In the science of mind we can neither understand nor be convinced of anything at second hand. Here testimony can impose no belief, and instruction is only instruction as it enables us to teach ourselves. A fact of consciousness, however accurately observed, however clearly described, and however great maybe our confidence in the observer, is for us as zero, until we have observed and recognized it ourselves. Till that be done we cannot realize its possibility, far less admit its truth. Thus it is that, in the philosophy of mind, instruction can do little more than point out the position in which the pupil ought to place himself, in order to verify, by his own experience, the facts which his instructor proposes to him as true.—HAMILTON *Metaphysics,* lect. 1, p. 11. (G. & L., 1859.)

3004. SCIENCE, PRACTICAL—*A Message of, to Man about Himself.*—What science has to say about himself is of transcendent interest to man, and the practical bearings of this theme are coming to be more vital than any on the field of knowledge.—DRUMMOND *Ascent of Man,* pref., p. 5. (J. P., 1900.)

3005. ——— ——— *Utility Sought and Attained—Treatment of Soil to Avoid Frost.* —From the fact of the great heat-absorption by dark soils, the increased loss of heat by night necessarily follows. In such districts the occurrence of night frosts is promoted in a high degree, a result that is of the greatest importance to vegetation. Experiments on a great scale have been made in the black, low grounds of North Germany—for instance, in Drömling, the

great marsh at the source of the rivers Aller and Ohre. These resulted in the interesting discovery that on clear nights the nightly minimal temperature was several degrees lower upon the uncovered black moor earth than upon neighboring places close by of a different character of soil. But if the moor soil was covered with a layer of sand ten centimeters in thickness, as is the procedure in tilling the moor dikes, the difference in the radiation of heat immediately disappeared, so that this greatest danger to vegetation was materially lessened.—ASSMAN, *article on Klima*, p. 157, in KIRCHHOFF'S *Anleitung zur deutschen Landes- und Volksforschung.* (Translated for *Scientific Side-Lights.*)

3006. SCIENCE REPLACING SUPERSTITION—*Observation and Reasoning Correct Disorders of Imagination.*—Among nations least advanced in civilization the imagination revels in strange and fantastic creations, and, by its predilection for symbols, alike influences ideas and language. Instead of examining, men are led to conjecture, dogmatize, and interpret supposed facts that have never been observed. The inner world of thought and of feeling does not reflect the image of the external world in its primitive purity. That which in some regions of the earth manifested itself as the rudiments of natural philosophy, only to a small number of persons endowed with superior intelligence, appears in other regions, and among entire races of men, to be the result of mystic tendencies and instinctive intuitions. An intimate communion with Nature, and the vivid and deep emotions thus awakened, are likewise the source from which have sprung the first impulses toward the worship and deification of the destroying and preserving forces of the universe. But by degrees, as man, after having passed through the different gradations of intellectual development, arrives at the free enjoyment of the regulating power of reflection, and learns by gradual progress, as it were, to separate the world of ideas from that of sensations, he no longer rests satisfied merely with a vague presentiment of the harmonious unity of natural forces; thought begins to fulfil its noble mission, and observation, aided by reason, endeavors to trace phenomena to the causes from which they spring.—HUMBOLDT *Cosmos*, vol. i, int., p. 37. (H., 1897.)

3007. SCIENCE, ROMANCE OF—*The Story of Man.*—The last romance of science, the most daring it has ever tried to pen, is the story of the ascent of man. Withheld from all the wistful eyes that have gone before, whose reverent ignorance forbade their wisest minds to ask to see it, this final volume of natural history has begun to open with our century's close.—DRUMMOND *Ascent of Man*, ch. 1, p. 1. (J. P., 1900.)

3008. SCIENCE, SPURIOUS, IN EARLY EGYPT—*A Record of Dead Facts.*—Of science properly so called the Egyptian had none. He claimed to have made records of natural facts for ages, such, for example, as astronomical observations, which as he boasted, had been kept up for six thousand centuries. But out of this vast storehouse of accumulated data not a single theory explanatory of the motions of the heavenly bodies ever emerged. He heaped up facts as he did the stones of the great pyramid, with infinite labor, and over a great interval of time, but the mountain of facts was as lifeless as the mountain of stone. It was dead, it held the dead, and there was no health in it.—PARK BENJAMIN *Intellectual Rise in Electricity*, ch. 2, p. 3[illegible] (J. W., 1898.)

3009. SCIENCE TEACHES PROTECTION—*Pasteurization or Sterilization of Milk*—The bacteria causing the diseases conveyable by milk succumb at much lower temperatures than the boiling-point. Advantage is taken of this in the process known as "pasteurization." By this method the milk is heated to 167-185° F. (75-85° C.). Such a temperature kills harmful microbes, because 75° C. is decidedly above their average thermal death-point, and yet the physical changes in the milk are practically nil because 85° C. does not relatively approach the boiling-point. There is no fixed standard for pasteurization, except that it must be above the thermal death-point of pathogenic bacteria, and yet below the boiling point. As a matter of fact, 158° F. (70° C.) will kill all souring bacteria as well as disease-producing organisms found in milk. If the milk is kept at that temperature for ten or fifteen minutes we say it has been "pasteurized." If it has been boiled with or without pressure, for half an hour we say it has been "sterilized."—NEWMAN *Bacteria*, ch. 6, p. 208. (G. P. P., 1899.)

3010. SCIENCE TEACHES THE NATURALNESS OF RELIGION—*Religion Shows the Supernaturalness of Nature.*—No science contributes to another without receiving a reciprocal benefit. And even as the contribution of science to religion is the vindication of the naturalness of the supernatural, so the gift of religion to science is the demonstration of the supernaturalness of the natural. Thus, as the supernatural becomes slowly natural, will also the natural become slowly supernatural, until in the impersonal authority of law men everywhere recognize the authority of God.—DRUMMOND *Natural Law in the Spiritual World*, pref., p. 20. (H. Al.)

3011. SCIENCE THE GREAT EXPOSITOR—*Religion Purified by Science—Science Exalted by Religion.*—Herbert Spencer points out, with how much truth need not now be discussed, that the purification of religion has always come from science. It is very apparent, at all events, that an immense debt must soon be contracted. The shifting of the furnishings will be a work of time.

But it must be accomplished. And not the least result of the process will be the effect upon science itself. No department of knowledge ever contributes to another without receiving its own again with usury—witness the reciprocal favors of biology and sociology. From the time that Comte defined the analogy between the phenomena exhibited by aggregations of associated men and those of animal colonies the science of life and the science of society have been so contributing to one another that their progress since has been all but hand-in-hand. A conception borrowed by the one has been observed in time finding its way back, and always in an enlarged form, to further illuminate and enrich the field it left. So must it be with science and religion. If the purification of religion comes from science, the purification of science, in a deeper sense, shall come from religion. The true ministry of Nature must at last be honored, and science take its place as the great expositor.—DRUMMOND *Natural Law in the Spiritual World,* int., p. 27. (H. Al.)

3012. SCIENCE, THE STUDY OF, AWAKENS THE THIRST FOR KNOWLEDGE—Recognition of the truth is the object of every science, but research into natural science has the advantage of being calculated to put into practise and to confirm the striving after knowledge. In this respect it proves a specially valuable means of education. Even mathematics is inferior to it.—MAGNUS *Address as Rector (Rektoralsrede).* (Translated for *Scientific Side-Lights.)*

3013. SCIENCE TO BE CULTIVATED FOR ITS OWN SAKE—*Love of Truth a Sufficient Motive.*—This, then, is the core of the whole matter as regards science. It must be cultivated for its own sake, for the pure love of truth, rather than for the applause or profit that it brings. . . . Could we have seen these men at work, without any knowledge of the consequences of their work, what should we have thought of them? To the uninitiated in their day they might often appear as big children playing with soap-bubbles and other trifles. It is so to this hour. Could you watch the true investigator—your Henry or your Draper, for example—in his laboratory, unless animated by his spirit, you could hardly understand what keeps him there. Many of the objects which rivet his attention might appear to you utterly trivial, and if you were to ask him what is the use of his work the chances are that you would confound him. He might not be able to express the use of it in intelligible terms. He might not be able to assure you that it will put a dollar into the pocket of any human being, living or to come. That scientific discovery may put not only dollars into the pockets of individuals, but millions into the exchequers of nations, the history of science amply proves; but the hope of its doing so never was, and it never can be, the motive power of the investigator.—TYNDALL *Lectures on Light,* p. 213. (A., 1898.)

3014. SCIENCE, TRANSFORMATION OF—*Beginning of Nineteenth Century in Germany — Medieval Ideas Still Prevalent— "Phlogiston," the Fire Element.*—It is difficult for us to realize the condition of natural science as it existed in Germany, at least in the first twenty years of this century. Magnus was born in 1802; I myself nineteen years later; but when I go back to my earliest recollections, when I began to study physics out of the school-books in my father's possession, who was himself taught in the Cauer Institute, I still see before me the dark image of a series of ideas which seems now like the alchemy of the Middle Ages. Of Lavoisier's and of Humphry Davy's revolutionizing discoveries not much had got into the school-books. Altho oxygen was already known, yet phlogiston, the fire element, played also its part. Chlorin was still oxygenated hydrochloric acid; potash and lime were still elements. Invertebrate animals were divided into insects and reptiles, and in botany we still counted stamens.—HELMHOLTZ *Popular Lectures,* lect. 1, p. 10. (L. G. & Co., 1898.)

3015. SCIENCE, VICISSITUDES OF A—*The Early Days of Chemistry—Alchemists First Favored, Then Persecuted.*—Chemistry has been the wonder-child among the natural sciences. None of her sisters ever followed such objects of adventure, or ever fulfilled so strange a destiny as hers. There was a time when chemistry believed in all earnest that within the dark lap of Nature there was a secret treasure to be found called the philosopher's stone. At that time chemistry was in high esteem among the great of the earth, and was clothed in purple as long as avarice could entertain that belief; but when men imagined themselves betrayed in their hopes of discovering [the secret of transmuting the baser metals into] gold they offered the gallows and the wheel for its followers (frequently unworthy enough, it must be acknowledged). And, in fact, the church regarded the salvation of believers as endangered by these black arts, and hurled against them banns and bull.—PETTENKOFER *Lecture, Was bedeutet die Chemie für die Physiologie?* p. 4. (Translated for *Scientific Side-Lights.)*

3016. SCIENCES, INTERDEPENDENCE OF—*Medicine Developed Botany.*—The science of medicine, which was founded by Dioscorides in the school of Alexandria, when considered with reference to its scientific development, is essentially a creation of the Arabs, to whom the oldest, and at the same time one of the richest, sources of knowledge, that of the Indian physicians, had been early opened. Chemical pharmacy was created by the Arabs, while to them are likewise due the first official prescrip-

tions regarding the preparation and admixture of different remedial agents—the dispensing recipes of the present day. These were subsequently diffused over the south of Europe by the school of Salerno. Pharmacy and materia medica, the first requirements of practical medicine, led simultaneously, in two directions, to the study of botany and to that of chemistry. From its narrow sphere of utility and its limited application, botany gradually opened a wider and freer field, comprehending investigations into the structure of organic tissues and their connection with vital forces, and into the laws by which vegetable forms are associated in families, and may be distinguished geographically according to diversities of climate and differences of elevation above the earth's surface.—HUMBOLDT *Cosmos*, vol. ii, pt. ii, p. 210. (H., 1897.)

3017. SCIENTIST LOYAL TO OPPOSING CHURCH — *Copernicus Dedicates Great Discovery to the Pope.*—When Copernicus is describing, in his dedication to the pope, the origin of his work, he does not scruple to term the opinion generally expressed among theologians of the immobility and central position of the earth "an absurd acroama," and to attack the stupidity of those who adhere to so erroneous a doctrine. "If even," he writes, "any empty-headed babblers (ματαιολόγοι), ignorant of all mathematical science, should take upon themselves to pronounce judgment on his work through an intentional distortion of any passage in the Holy Scriptures . . . . he should despise so presumptuous an attack. It was, indeed, universally known that the celebrated Lactantius, who, however, could not be reckoned among mathematicians, had spoken childishly *(pueriliter)* of the form of the earth, deriding those who held it to be spherical. On mathematical subjects one should write only to mathematicians. In order to show that, deeply penetrated with the truth of his own deductions, he had no cause to fear the judgment that might be passed upon him, he turned his prayers from a remote corner of the earth to the head of the church, begging that he would protect him from the assaults of calumny, since the church itself would derive advantage from his investigations on the length of the year and the movements of the moon." Astrology and improvements in the calendar long procured protection for astronomy from the secular and ecclesiastical powers, as chemistry and botany were long esteemed as purely subservient auxiliaries to the science of medicine.—HUMBOLDT *Cosmos*, vol. ii, pt. ii, p. 307. (H., 1897.)

3018. SCIENTIST MUST BECOME AS A LITTLE CHILD—In the law book of research in natural science we read the same command as in the Scriptures, "Verily I say unto you, except ye become as a little child, ye shall not enter into the kingdom of heaven." Accordingly, we see the investigator everywhere making an earnest effort to return to the standpoint of a child that forgets all sorrow as soon as something that moves is furnished him to look at, it matters little what—a tin plate set to spin, or a kitten at her play. But, of course, between the manner in which the scientist marvels at these phenomena, and that of the child, there lies the chasm that separates the moral value of a human being, ripened by experience, from the innocence of a child.—DU BOIS-REYMOND, *a lecture, Tierische Bewegung.* (Translated for *Scientific Side-Lights.)*

3019. SCIENTISTS FOILED BY A KING— *The "April Moon"—Laplace Astounded—Arago Seeks Instruction from Gardeners.*—"I am delighted to see you collected round me," said Louis XVIII. one day to the members composing a deputation from the *Bureau des Longitudes,* who had gone to present to him the "Connaissance des Temps" and the "Annuaire," "for you will explain to me what the April moon is, and its mode of action on the crops." Laplace, to whom he more especially addressed these words, was astounded. He who had written so much on the moon had never, in fact, thought of the April moon. He consulted all his neighbors by a look, but seeing nobody disposed to speak, he determined to reply himself. "Sire, the April moon does not hold any place in astronomical theories; we are not, then, able to satisfy the curiosity of your Majesty." In the evening, during his game, the king was very merry over the embarrassment in which he had placed the members of his *Bureau des Longitudes.* Laplace heard of it, and went to ask Arago if he could enlighten him about this famous April moon, which had been the subject of such a disagreeable mishap. Arago went for information to the gardeners of the *Jardin des Plantes.*—FLAMMARION *Popular Astronomy*, bk. ii, ch. 8, p. 174. (A.)

3020. SCIENTISTS READ KING'S RIDDLE—*The "April Moon"—Popular Observation True—Popular Theory False.*—Gardeners give the name of "April moon" to the moon which commences in April and becomes full either at the end of that month or, more usually, in the course of May. In popular opinion the light of the moon in April and May exercises an injurious action on the young shoots of plants. They are confident of having observed that on the nights when the sky is clear the leaves and buds exposed to this light are blighted—that is to say, are frozen—altho the thermometer in the atmosphere stands at several degrees above zero. They add, however, that if a clouded sky arrests the lunar rays, and prevents them reaching the plants, the same effects no longer take place, in circumstances of temperature, moreover, perfectly similar. These phenomena seem to indicate that the light of our satellite may be endowed with a

certain freezing effect. Nevertheless, in directing the largest lenses and reflectors towards the moon, and then placing in their focus very delicate thermometers, nothing has ever been perceived which could justify such a singular conclusion. . . . The following is the explanation:

The physicist Wells first ascertained that at night objects may acquire a temperature different from that of the atmosphere which surrounds them. This important fact is now proved. If we place in the open air small pieces of cotton, eiderdown, etc., we often find that their temperature is six or seven or even eight degrees centigrade below the temperature of the surrounding atmosphere. Vegetables are in the same case. We cannot, then, judge of the cold which a plant has experienced in the night by the sole indications of a thermometer suspended in the atmosphere. Place a thermometer flat on the ground: its temperature will descend below that of the air, if the sky is very clear. A plant may be much frozen, altho the air may be constantly maintained at several degrees above zero [centigrade].

These differences of temperature are only produced in perfectly clear weather. If the sky is cloudy the difference disappears entirely or becomes imperceptible. In the nights of April and May the temperature is often only a few degrees above zero [centigrade]. At that time plants exposed to the light of the moon—that is to say, to a clear sky—may be frozen, notwithstanding the thermometer. If the moon, on the contrary, does not shine, if the sky is cloudy, the temperature of the plants not descending below that of the atmosphere, they would not freeze—at least not till the thermometer has marked zero. It is, then, true, as the gardeners assert, that with quite similar thermometric circumstances a plant may be frozen or not, according as the moon is visible or hidden behind clouds. If they are mistaken, it is only in the conclusions—that is, in attributing the effect to the light of the moon. The lunar light is here but an index of a clear atmosphere: it is in consequence of the clearness of the sky that the nocturnal freezing of the plants is effected [through the radiation of their heat into space]. The moon contributes in no way to the result. Whether it is set or on the horizon the phenomenon would be the same.—FLAMMARION *Popular Astronomy*, bk. ii, ch. 8, p. 174. (A.)

3021. SCULPTURE AND PAINTING, INFANCY OF—*Modern Work of Untaught Rustics Like Ancient Idols.*—The painter's and sculptor's art seems to have arisen in the world from the same sort of rude beginnings which are still to be seen in children's attempts to draw and carve. The sheets of bark or skins on which barbarous tribes have drawn men and animals, guns and boats, remind us of the slates and barn doors on which English children make their early trials in outline. Many of these children will grow up and go through their lives without getting much beyond this childish stage. The clergyman of a country parish some years ago set the cottagers to amuse themselves with carving in wood such figures as men digging or reaping. They produced figures so curiously uncouth, and in style so like the idols of barbarous tribes, that they were kept as examples of the infancy of sculpture, and are now to be seen in the museum of Kew Gardens.—TYLOR *Anthropology*, ch. 12, p. 300. (A., 1899.)

3022. SCULPTURE, GREEK, INDEBTED TO ASSYRIANS AND EGYPTIANS—*Painting of Ancient Statuary.*—Greek art is sometimes written of as tho it had itself begun in the rudest stage, with clumsy idols of wood and clay, till by efforts of their own surpassing genius the Greek sculptors came to hew in marble the forms which are still the wonders of the world. But great as Greek genius was, it never did this. The Greek nations had been for ages in contact with the older civilizations of the Mediterranean; their starting-point was to learn what art could do in Egypt, Phenicia, Babylonia: and then their genius set them free from the hard old conventional forms, leading them to model life straight from Nature, and even to fashion in marble shapes of ideal strength and grace. The Egyptian sculptors would not spoil polished granite with paint, but many of their statues were colored, and there are traces of paint left on the Assyrian sculptures and on Greek statues, so that we are apt to have a wrong idea of a Greek temple, as tho its marble gods and goddesses used to be of the glaring whiteness of a modern sculpture-gallery. The Greek terra-cotta statuettes in the British Museum are models of antique female grace in form and costume, only wanting the lost color restored to make them the prettiest things in the world.—TYLOR *Anthropology*, ch. 12, p. 303. (A., 1899.)

3023. SEA, EARTHQUAKES ORIGINATING BENEATH—*Steam the Motive Power of Volcanic Eruptions.*—It may here be remarked that a very large proportion of the destructive earthquakes of the world have originated beneath the sea, along the base of continental domes which are unusually steep. On the top of these slopes, which, for example, form the backbone of Japan and Peru, we find volcanic vents. Where strong folding of the earth's crust has taken place, as in the Alps and Himalayas, but at a distance from the sea, earthquakes may be frequent whilst volcanic eruptions are unknown. Earthquakes occur where rock-folding is in progress, and volcanoes are found where maxima of folding have taken place, providing the site of these is sufficiently near large bodies of water, which supply the moisture which, when converted into steam, is the motive power for all great eruptions.—MILNE *Earthquakes*, ch. 17, p. 285. (A., 1899.)

3024. SEA, MOUNTAIN CAST INTO—*Earthquake in Hindustan.*—The town of Chittagong, in Bengal, was violently shaken by an earthquake on the 2d of April, 1762, the earth opening in many places and throwing up water and mud of a sulfureous smell. At a place called Bardavan a large river was dried up; and at Bar Charra, near the sea, a tract of ground sunk down and 200 people, with all their cattle, were lost. It is said that sixty square miles of the Chittagong coast suddenly and permanently subsided during this earthquake, and that Ces-lung-Toom, one of the Mug Mountains, entirely disappeared, and another sank so low that its summit only remained visible. Four hills are also described as having been variously rent asunder, leaving open chasms from thirty to sixty feet in width. Towns which subsided several cubits were overflowed with water; among others, Deep Gong, which was submerged to the depth of seven cubits. Two volcanoes are said to have opened in the Secta Cunda Hills. The shock was also felt at Calcutta. While the Chittagong coast was sinking, a corresponding rise of the ground took place at the island of Ramree and at Cheduba.—LYELL *Principles of Geology,* bk. ii, ch. 29, p. 494. (A., 1854.)

3025. SEA-SHELLS ABOVE HIGH-WATER MARK—*Elevation of Land in Earthquake.*—The most remarkable effect of this earthquake [the Chilean earthquake in 1835] was the permanent elevation of the land; it would probably be far more correct to speak of it as the cause. There can be no doubt that the land round the Bay of Concepcion was upraised two or three feet; but it deserves notice that owing to the wave having obliterated the old lines of tidal action on the sloping sandy shores, I could discover no evidence of this fact, except in the united testimony of the inhabitants, that one little rocky shoal, now exposed, was formerly covered with water. At the island of S. Maria (about thirty miles distant) the elevation was greater; on one part, Captain Fitz Roy found beds of putrid mussel-shells still adhering to the rocks, ten feet above high-water mark: the inhabitants had formerly dived at low-water spring-tides for these shells. The elevation of this province is particularly interesting from its having been the theater of several other violent earthquakes, and from the vast numbers of sea-shells scattered over the land, up to a height of certainly 600, and, I believe, of 1,000 feet. At Valparaiso, as I have remarked, similar shells are found at the height of 1,300 feet: it is hardly possible to doubt that this great elevation has been effected by successive small uprisings, such as that which accompanied or caused the earthquake of this year, and likewise by an insensibly slow rise, which is certainly in progress on some parts of this coast.—DARWIN *Naturalist's Voyage around the World,* ch. 14, p. 310. (A., 1898.)

3026. SEA-WAVES UPON THE LAND—*Earthquake Piling up Waters—Ships Driven Inland.*—At the earthquake in St. Thomas, in 1868, it is said that the water receded shortly before the first shock. When it returned, after the second shock, it was sufficient to throw the U. S. ship "Monongahela" high and dry. Another American ship, the "Wateree," was also lost in 1868 by being swept a quarter of a mile inland by the sea-wave which inundated Arica. The sea-waves of 1877 removed it still further inland. Much of the great destruction which occurred at the time of the great Lisbon earthquake was due to a series of great sea-waves, thirty to sixty feet higher than the highest tide, which swamped the town. These came in about an hour after the town had been shattered by the motion of the ground. The first motion in the waters was their withdrawal, which was sufficient to completely uncover the bar at the mouth of the Tagus. At Cadiz, the first wave, which was the greatest, is said to have been sixty feet in height. Fortunately the devastating effect which this would have produced was partially warded off by cliffs.—MILNE *Earthquakes,* ch. 9, p. 165. (A., 1899.)

3027. SECLUSION OF WOMEN—*Its Tendency to Refinement.*—The seclusion of women and their always eating apart by a roundabout way tended to their refinement and advancement and protection. It called for more services, and time in service. It consumed the hours in organized and regulated labor. It was discipline. In this coterie were included frequently the children and the old men. It is said that in times of scarcity the women were pinched with hunger first, but no one ever heard of a cook starving to death. This seclusion is also an evidence of the great independence and self-help developed in the priscan women.—MASON *Woman's Share in Primitive Culture,* ch. 10, p. 235. (A., 1894.)

3028. SECRETIVENESS TOWARD SUPERIORS—The impulse to conceal is more apt to be provoked by superiors than by equals or inferiors. How differently do boys talk together when their parents are not by! Servants see more of their masters' characters than masters of servants'. Where we conceal from our equals and familiars, there is probably always a definite element of prudential prevision involved. Collective secrecy, mystery, enters into the emotional interest of many games, and is one of the elements of the importance men attach to freemasonries of various sorts, being delightful apart from any end.—JAMES *Psychology,* vol. ii, ch. 24, p. 433. (H. H. & Co., 1899.)

3029. SECRET OF COMETS DISCOVERED — *Self-luminous Bodies — Their Light from Glowing Gas.*—The first suc-

cessful application of the spectroscope to comets was by Donati in 1864. A comet discovered by Tempel, July 4, brightened until it appeared like a star somewhat below the second magnitude, with a feeble tail 30° in length. It was remarkable as having, on August 7, almost totally eclipsed a small star—a very rare occurrence. On August 5 Donati admitted its light through his train of prisms, and found it, thus analyzed, to consist of three bright bands—yellow, green, and blue—separated by wider dark intervals. This implied a good deal. Comets had previously been considered, as we have seen, to shine mainly, if not wholly, by reflected sunlight. They were now perceived to be self-luminous, and to be formed, to a large extent, of glowing gas. The next step was to determine what kind of gas it was that was thus glowing in them; and this was taken by Dr. Huggins in 1868. . . . All the eighteen comets tested by light-analysis, between 1868 and 1880, showed the typical hydrocarbon spectrum common to the whole group of those compounds, but probably due immediately to the presence of acetylene.—CLERKE *History of Astronomy,* pt. ii, ch. 10, p. 414. (Bl., 1893.)

3030. SECRETS REVEALED—*Foreign Substances in the Body Shown by Roentgen Rays—The Mercy of Civilization.*—Flesh and skin are transparent in moderate thicknesses, while bone is opaque. Hence, if the rays [Roentgen] are passed through the hand the bones cast a shadow, tho an invisible one; and as, most fortunately, the rays act upon photographic plates almost like ordinary light, hands or other parts of the body can be photographed by their shadows, and will show the bones by a much darker tint. Hence their use in surgery, to detect the exact position of bullets or other objects embedded in the flesh or bone. A needle which penetrated the knee-joint and then broke off, leaving a portion embedded which set up inflammation, and might have necessitated the loss of the limb, was shown so accurately that a surgeon cut down to it and got it out without difficulty.—WALLACE *The Wonderful Century,* ch. 5, p. 40. (D. M. & Co., 1899.)

3031. SECURITY BY PRECAUTION—*Disinfection of Milk Possible—Sterilizing by Heat.*—If for practical purposes we look upon all milk derived from tubercular udders as highly infective, we may adopt a comparatively simple and efficient remedy. To avoid all danger it is sufficient to bring the milk to a boil for a few minutes before it is consumed; in fact, the temperature of 85° C. (160° F.) prolonged for five minutes kills all bacilli. The common idea that boiled milk is indigestible, and that the boiling causes it to lose much of its nutritive value, is largely groundless.—NEWMAN *Bacteria,* ch. 6, p. 197. (G. P. P., 1899.)

3032. SECURITY FROM INFECTION—*Putrefaction within the Law of Cause and Effect—Bacteria.*—Our knowledge here, as elsewhere in connection with this subject, has been vastly extended by Professor Cohn, of Breslau. "No putrefaction," he says, "can occur in a nitrogenous substance if its bacteria be destroyed and new ones prevented from entering it. Putrefaction begins as soon as bacteria, even in the smallest numbers, are admitted either accidentally or purposely. It progresses in direct proportion to the multiplication of the bacteria, it is retarded when they exhibit low vitality, and it is stopped by all influences which either hinder their development or kill them. All bactericidal media are therefore antiseptic and disinfecting."—TYNDALL *Floating Matter of the Air,* essay 5, p. 287. (A., 1895.)

3033. SEED-DISPERSAL—*Compensations for Vegetable Immobility—Children Given a New Start in Life.*—If each seed fell where it grew, the spread of the species would shortly be at an end. But Nature, working on the principle of cooperation, is once more redundant in its provisions. By a series of new alliances the offspring are given a start on distant and unoccupied ground; and so perfect are the arrangements in this department of the struggle for the life of others that single plants, immovably rooted in the soil, are yet able to distribute their children over the world. By a hundred devices the fruits and seeds when ripe are entrusted to outside hands—provided with wing or parachute and launched upon the wind, attached by cunning contrivances to bird and beast, or dropped into stream and wave and ocean-current, and so transported over the earth.—DRUMMOND *Ascent of Man,* ch. 7, p. 237. (J. P., 1900.)

3034. ——— ——— *Seed Distributor Rolled by Wind—The Russian Thistle.*—The Russian thistle begins its yearly growth in a simple, inoffensive way. The young plants are slender and succulent, but as they grow older they harden and spread out, becoming densely covered with sharp spines. When full grown they often reach a diameter of four or five feet, a majority of the specimens being distinctly rounded in outline. After the seeds have matured the stem twists around and breaks off, thus leaving the plant to roll wherever the wind blows it, dropping its seeds as it goes along. As one large plant sometimes produces 200,000 seeds, and may be blown for miles, one can readily imagine how soon a prairie region might be overrun by the pest, which grows so vigorously that it crowds out practically all plants with which it comes in competition.—WEED *Seed Travellers,* pt. i, p. 23. (G. & Co., 1899.)

3035. ——— ——— *Seeds Carried by Birds—The Holly—The American Currant.*—What holly loses in the size of its clusters, it gains in the brightness of its berries.

Against the dark green of the leaves, the berries stand out with great prominence. Their after-history is instructive enough. A holly-berry is gobbled up by a bird with ease. What of the seeds the berries contain? Does digestion, which in a bird is a tolerably rough and mechanical process, destroy the seeds? Not so. The seeds, encased each in its dense tough covering, resist even the digestion of the bird's gizzard and stomach, and they are passed on uninjured through the alimentary tract of the animal. Thus liberated, and the bird being the gainer by its digestion of the soft parts of the berries, the holly-seeds fall into the soil and grow up each in time to the holly-tree. Note again how this interaction between bird and fruit serves another useful purpose. Birds traverse leagues of country in their peregrinations. They may thus convey the holly-seeds to regions hundreds of miles from the parent tree whence the berries were plucked. . . . We owe much to the dispersal of seeds by such agencies. There is a plant of the New World, the American currant, which long ago was introduced into France, for the sake of the dark red juice of its berries, which was used to color wines. At Bordeaux this currant was extensively cultivated. Man introduced the plant, but mark the greater influence of the color of its fruits and the work of the birds. Now, the American currant is found universally throughout the south of France. It has spread also into Switzerland, and has reached the Tyrol. You can, therefore, prophesy with considerable safety regarding plants and their chances of distribution, when you see these fruits and learn the story of their distribution. Holly-berries have social associations dear to the hearts of us all. They possess, however, in their redness and in their attraction for bird-visitors, a romance that is all their own.—WILSON *Glimpses of Nature,* ch. 22, p. 73. (Hum., 1892.)

3036. ——— ——— *Seeds Flung Afar —The "Catapult Fruits."*—The calyx of sage, bergamot, and most other mints remains dry and stiff, as a cup to hold one to four little round nutlets as they ripen. . . . When dry, the plant behaves somewhat as follows: when the wind jostles the branches against each other, or when an animal of some kind hits the plant, this movement causes many of these cups to get caught; but the elastic stem comes suddenly back to its place, and in so doing flips a nutlet or more from its mouth one to six feet, somewhat as a boy would flip a pea with a pea-shooter. In our garden, July 2, when plants of sage, *Salvia interrupta,* were ripening their fruit, we found it difficult to collect any seeds, but seedlings were observed in abundance on every side of the plant, some to the distance of six feet. Plants dispersing seeds in this manner have been called catapult fruits.—BEAL *Seed Dispersal,* ch. 5, p. 50. (G. & Co., 1898.)

3037. ——— ——— *Seeds Scattered Like Snowflakes.*—The seeds of willow and poplar are covered with white downy silk, by means of which they are borne through the air in summer, often so filling it as to suggest a light snow-storm.—WEED *Seed Travellers,* ch. 1, p. 3. (G. & Co., 1899.)

3038. ——— ——— *Seeds Transported by Rivers.*—"The mountain stream or torrent," observes Keith, "washes down to the valley the seeds which may accidentally fall into it, or which it may happen to sweep from its banks when it suddenly overflows them. The broad and majestic river, winding along the extensive plain, and traversing the continents of the world, conveys to the distance of many hundreds of miles the seeds that may have vegetated at its source. Thus the southern shores of the Baltic are visited by seeds which grew in the interior of Germany, and the western shores of the Atlantic by seeds that have been generated in the interior of America." Fruits, moreover, indigenous to America and the West Indies, such as that of the *Mimosa scandens,* the cashewnut and others, have been known to be drifted across the Atlantic by the Gulf Stream, on the western coasts of Europe, in such a state that they might have vegetated had the climate and soil been favorable. Among these the *Guilandina Bonduc,* a leguminous plant, is particularly mentioned, as having been raised from a seed found on the west coast of Ireland.—LYELL *Principles of Geology,* bk. iii, ch. 37, p. 620. (A., 1854.)

3039. ——— ——— *Seeds Transported in Mud—Animals as Seed Distributors.*—Seeds and fruits of aquatic and bog plants that are floating, or in the mud of shallow water, are often carried by ducks, herons, swallows, muskrats, and other frequenters of such places, on their feet, beaks, or feathers, as they hastily leave one place for another. In this way seeds of water plantain, sedges, grasses, rushes, docks, arrowhead, pondweeds, duckweed, cat-tail flag, bur reed, bladderwort, water crowfoot, and many others are transported from one pond, lake, or stream to another. In some cases enough of a living plant may be detached and carried away to keep on growing. Darwin found on the feet of some birds six and three-quarter ounces of mud, in which were five hundred and thirty-seven seeds that germinated. Mud may be carried on the feet of land animals as well as on aquatic animals, not only from the ponds and bogs, but from the fields where seeds may have accumulated in the earth or washed down the slopes.—BEAL *Seed Dispersal,* ch. 7, p. 71. (G. & Co., 1898.)

3040. ——— ——— *Worms Bury Seeds in the Earth—Chambers under Ground Carefully Lined by Worm Builders.*—I found at Abinger, in Surrey, two burrows termina-

ting in similar chambers at a depth of 36 and 41 inches, and these were lined or paved with little pebbles about as large as mustard-seeds; and in one of the chambers there was a decayed oat-grain, with its husk. Hensen likewise states that the bottoms of the burrows are lined with little stones; and where these could not be procured, seeds, apparently of the pear, had been used, as many as fifteen having been carried down into a single burrow, one of which had germinated. We thus see how easily a botanist might be deceived who wished to learn how long deeply buried seeds remained alive, if he were to collect earth from a considerable depth, on the supposition that it could contain only seeds which had long lain buried. It is probable that the little stones, as well as the seeds, are carried down from the surface by being swallowed; for a surprising number of glass beads, bits of tile and of glass were certainly thus carried down by worms kept in pots; but some may have been carried down within their mouths. The sole conjecture which I can form why worms line their winter quarters with little stones and seeds, is to prevent their closely coiled-up bodies from coming into close contact with the surrounding cold soil; and such contact would perhaps interfere with their respiration, which is effected by the skin alone.—DARWIN *Formation of Vegetable Mould*, ch. 2, p. 33. (Hum., 1887.)

3041. SEEDS, PROFUSION OF—*Abundance in Nature.*—In producing seeds Nature is generous, often lavish. Most seeds are eaten by animals, or fall in places where they cannot germinate and produce plants, or fall in such numbers that most of them in growing are crowded and starved to death. A very small proportion fall on good ground, and succeed in becoming fruiting plants. A large plant of purslane produces one million two hundred and fifty thousand seeds; a patch of daisy fleabane, three thousand seeds to each square inch of space covered by a plant. The genuine student will not be satisfied till he has selected several different kinds of plants and counted, or estimated, the number of seeds produced by each, or the number of seeds furnished to the area covered by one or by several plants.—BEAL *Seed Dispersal*, ch. 7, p. 78. (G. & Co., 1898.)

3042. SEEING WITHOUT PERCEIVING—*Habitual Acts Automatic—Not Recognized by Consciousness Nor Held in Memory.*—When we move about in a room with the objects in which we are quite familiar, we direct our steps so as to avoid them, without being conscious what they are, or what we are doing; we see them, as we easily discover if we try to move about in the same way with our eyes shut, but we do not perceive them, the mind being fully occupied with some train of thought. In like manner, when we go through a series of familiar acts, as in dressing or undressing ourselves, the operations are really automatic; once begun, we continue them in a mechanical order, while the mind is thinking of other things; and if we afterward reflect upon what we have done, in order to call to mind whether we did or did not omit something, as for instance to wind up our watch, we cannot satisfy ourselves except by trial, even tho we had actually done what we were in doubt about. It is evident, indeed, that in a state of profound reverie or abstraction a person may, as a somnambulist sometimes does, see without knowing that he sees, hear without knowing that he hears, and go through a series of acts scarcely, if at all, conscious of them at the time, and not remembering them afterward.—MAUDSLEY *Body and Mind*, lect. 1, p. 23. (A., 1898.)

3043. SELECTION AMONG SIMULTANEOUS POSSIBILITIES—*Mind Works as a Sculptor on Marble—The Statue in the Stone.*—The mind is at every stage a theater of simultaneous possibilities. Consciousness consists in the comparison of these with each other, the selection of some, and the suppression of the rest by the reenforcing and inhibiting agency of attention. The highest and most elaborated mental products are filtered from the data chosen by the faculty next beneath, out of the mass offered by the faculty below that, which mass in turn was sifted from a still larger amount of yet simpler material, and so on. The mind, in short, works on the data it receives very much as a sculptor works on his block of stone. In a sense the statue stood there from eternity. But there were a thousand different ones besides it, and the sculptor alone is to thank for having extricated this one from the rest.—JAMES *Psychology*, vol. i, ch. 9, p. 288. (H. H. & Co., 1899.)

3044. SELECTION A PROPERTY OF LIFE—*Each Organ and Tissue Takes from the Blood Its Own Material—A Mystery of Science.*—Each tissue . . . takes from the common stream of nourishment the materials necessary for the building-up of new substance. From the blood bone selects the materials necessary for the formation of new bone; nerve from the same source gathers matter for the production of new nerve-tissue; muscle therefrom elaborates new muscle; cells of wondrously diverse kind, like buyers of many nations in a common market, select from the blood the special food or pabulum suited to their wants, and therefrom manufacture new cells—in short, the process of growth in man and in all animals of higher grade exemplifies the results of many varied operations effected by the tissues and organs of the body upon the common material offered to them in the shape of the nutrient blood. How this property of "selection" is exercised, or what is its exact nature, science knows not as yet. But the possession of this remarkable property of selecting and using appropriate material in the actions of life, explain it how

we may, constitutes one of the most consistent and clearly defined distinctions which can be drawn between the world of life and the great encompassing universe of nonliving matter.—ANDREW WILSON *Facts and Fictions of Zoology*, p. 30. (Hum., 1882.)

3045. SELECTION, ARTIFICIAL, THE MAGICIAN'S WAND—*Agriculturist May Mold His Flock at Pleasure.*—Youatt, who was probably better acquainted with the works of agriculturists than almost any other individual, and who was himself a very good judge of animals, speaks of the principle of selection as "that which enables the agriculturist not only to modify the character of his flock, but to change it altogether. It is the magician's wand, by means of which he may summon into life whatever form and mold he pleases."—DARWIN *Origin of Species*, ch. 1, p. 27. (Burt.)

3046. SELECTION, ARTIFICIAL, UNCONSCIOUSLY PRACTISED BY SAVAGES—If there exist savages so barbarous as never to think of the inherited character of the offspring of their domestic animals, yet any one animal particularly useful to them, for any special purpose, would be carefully preserved during famines and other accidents, to which savages are so liable, and such choice animals would thus generally leave more offspring than the inferior ones, so that in this case there would be a kind of unconscious selection going on.—DARWIN *Origin of Species*, ch. 1, p. 31. (Burt.)

3047. SELECTION IMPLIES REJECTION—Selection implies rejection as well as choice; and the function of ignoring, of inattention, is as vital a factor in mental progress as the function of attention itself. —JAMES *Psychology*, vol. ii, ch. 22, p. 371. (H. H. & Co., 1899.)

3048. SELECTION, NATURAL—*In Man Devoted to Mind—Tools Take the Place of New Organs.*—As an optical instrument, the eye had well-nigh reached extreme perfection in many a bird and mammal ages before man's beginnings; and the essential features of the human hand existed already in the hands of Miocene apes. But different methods came in when human intelligence appeared upon the scene. Mr. Spencer has somewhere reminded us that the crowbar is but an extra lever added to the levers of which the arm is already composed, and the telescope but adds a new set of lenses to those which already exist in the eye. This beautiful illustration goes to the kernel of the change that was wrought when natural selection began to confine itself to the psychical modification of our ancestors. In a very deep sense all human science is but the increment of the power of the eye, and all human art is the increment of the power of the hand.—FISKE *Destiny of Man*, ch. 7, p. 59. (H. M. & Co., 1900.)

3049. ——— ——— *Not a Cause—Forms To Be Selected Must First Exist—Not Origin, but Success of Variations.*—Natural selection can do nothing except with the materials presented to its hands. It cannot select except among the things open to selection. Natural selection can originate nothing; it can only pick out and choose among the things which are originated by some other law. Strictly speaking, therefore, Mr. Darwin's theory is not a theory on the origin of species at all, but only a theory on the causes which lead to the relative success or failure of such new forms as may be born into the world. It is the more important to remember this distinction, because it seems to me that Mr. Darwin himself frequently forgets it.—ARGYLL *Reign of Law*, ch. 5, p. 130. (Burt.)

3050. ——— ——— *Personified—Organisms Invested with Power of Self-creation—Plants and Animals Credited with Design.*—In one of those most able expositions of the doctrine of the origin of species by natural selection, by which Professor Huxley very early impressed the educated public with the scientific value of the new views which Mr. Darwin had opened out, he remarked that nothing had more strongly impressed him than the fact that they had completely disposed of the old teleological argument; the adaptations in organized structures which had been regarded as evidences of "design" being sufficiently accounted for as results of the "survival of the fittest." And this view of the case has been so zealously adopted by some of the younger advocates of the doctrine that they have gone the length of representing the plants and animals which exhibit them as having made themselves for the purposes which their organization is found to answer—as if they had the intelligent design which is denied to an universal Creator. When challenged to justify that language they represent it as merely "figurative"; their intention being only to show that, as natural selection gives a sufficient account of the adaptiveness, there is no need to seek for any other explanation of it.—CARPENTER *Nature and Man*, lect. 15, p. 435. (A., 1889.)

3051. ——— ——— *Will Not Explain Man—Darwin Never Accounted for the Genesis of Man.*—Yet not only are there extensive regions in the doctrine of evolution about which Darwin knew very little, but even as regards the genesis of species his theory was never developed in his own hands so far as to account satisfactorily for the genesis of man. It must be borne in mind that while the natural selection of physical variations will go far toward explaining the characteristics of all the plants and all the beasts in the world, it remains powerless to account for the existence of man. Natural selection of physical variations might go on for a dozen eternities without any other visible result than new

forms of plant and beast in endless and meaningless succession.—FISKE *Through Nature to God,* pt. ii, ch. 5, p. 81. (H. M. & Co., 1900.)

3052. ——— *Wrought by Elemental Forces—Frost Destroys Weak Plants—The Thistle Spreads.*—That which wind and sea are to a sandy beach, the sum of influences, which we term the "conditions of existence," is to living organisms. The weak are sifted out from the strong. A frosty night "selects" the hardy plants in a plantation from among the tender ones as effectually as if it were the wind, and they the sand and pebbles of our illustration; or, on the other hand, as if the intelligence of a gardener had been operative in cutting the weaker organisms down. The thistle, which has spread over the pampas, to the destruction of native plants, has been more effectually "selected" by the unconscious operation of natural conditions than if a thousand agriculturists had spent their time in sowing it.—HUXLEY *Lay Sermons,* serm. 13, p. 317. (G. P. P., 1899.)

3053. SELECTION REQUIRES A HIGHER THAN HUMAN WISDOM—*Constantly Reaches Beyond Man's Intent.*—Hairless dogs have imperfect teeth; long-haired and coarse-haired animals are apt to have, as is asserted, long or many horns; pigeons with feathered feet have skin between their outer toes; pigeons with short beaks have small feet, and those with long beaks large feet. Hence, if man goes on selecting, and thus augmenting, any peculiarity, he will almost certainly modify unintentionally other parts of the structure, owing to the mysterious laws of correlation.—DARWIN *Origin of Species,* ch. 1, p. 11. (Burt.)

3054. SELF, EACH ONE'S SUPREME INTEREST IN—The most natively interesting object to a man is his own personal self and its fortunes. We accordingly see that the moment a thing becomes connected with the fortunes of the self it forthwith becomes an interesting thing. Lend the child his books, pencils, and other apparatus; then give them to him, make them his own, and notice the new light with which they instantly shine in his eyes. He takes a new kind of care of them altogether. In mature life all the drudgery of a man's business or profession, intolerable in itself, is shot through with engrossing significance because he knows it to be associated with his personal fortunes. What more deadly uninteresting object can there be than a railroad time-table? Yet where will you find a more interesting object if you are going on a journey, and by its means can find your train? At such times the time-table will absorb a man's entire attention, its interest being borrowed solely from its relation to his personal life.—JAMES *Talks to Teachers,* ch. 10, p. 95. (H. H. & Co., 1900.)

3055. SELF IN RELATION TO ENVIRONMENT—*Each Person Several Selves.*—Properly speaking, a man has as many social selves as there are individuals who recognize him and carry an image of him in their mind. To wound any one of these his images is to wound him. But as the individuals who carry the images fall naturally into classes, we may practically say that he has as many different social selves as there are distinct groups of persons about whose opinion he cares. He generally shows a different side of himself to each of these different groups. Many a youth who is demure enough before his parents and teachers swears and swaggers like a pirate among his "tough" young friends. We do not show ourselves to our children as to our club companions, to our customers as to the laborers we employ, to our own masters and employers as to our intimate friends. From this there results what practically is a division of the man into several selves, and this may be a discordant splitting, as where one is afraid to let one set of his acquaintances know him as he is elsewhere; or it may be a perfectly harmonious division of labor, as where one tender to his children is stern to the soldiers or prisoners under his command.—JAMES *Psychology,* vol. i, ch. 10, p. 294. (H. H. & Co., 1899.)

3056. SELFISHNESS IN ANIMAL LIFE—*Parasitism a Crime in Nature.*—Among animals these *lazzaroni* are more largely represented still. Almost every animal is a living poorhouse, and harbors one or more species of *Epizoa* or *Entozoa,* supplying them gratis, not only with a permanent home, but with all the necessaries and luxuries of life.

Why does the naturalist think hardly of the parasites? Why does he speak of them as degraded, and despise them as the most ignoble creatures in Nature? . . .

The naturalist's reply to this is brief. Parasitism, he will say, is one of the gravest crimes in Nature. It is a breach of the law of evolution. Thou shalt evolve, thou shalt develop all thy faculties to the full, thou shalt attain to the highest conceivable perfection of thy race—and so perfect thy race—this is the first and greatest commandment of Nature. But the parasite has no thought for its race, or for perfection in any shape or form. It wants two things—food and shelter. How it gets them is of no moment. Each member lives exclusively on its own account an isolated, indolent, selfish, and backsliding life.—DRUMMOND *Natural Law in the Spiritual World,* essay 9, p. 288. (H. Al.)

3057. SELFISHNESS IN DISGUISE OF SPIRITUALITY—*Mohammedan Paradise—True Spiritual Self-seeking.*—Under the head of spiritual self-seeking ought to be included every impulse towards psychic progress, whether intellectual, moral, or spiritual in the narrow sense of the term. It must be

admitted, however, that much that commonly passes for spiritual self-seeking in this narrow sense is only material and social self-seeking beyond the grave. In the Mohammedan desire for paradise and the Christian aspiration not to be damned in hell, the materiality of the goods sought is undisguised. In the more positive and refined view of heaven many of its goods, the fellowship of the saints and of our dead ones, and the presence of God, are but social goods of the most exalted kind. It is only the search of the redeemed inward nature, the spotlessness from sin, whether here or hereafter, that can count as spiritual self-seeking pure and undefiled.—JAMES *Psychology*, vol. i, ch. 10, p. 309. (H. H. & Co., 1899.)

3058. SELFISHNESS ON THE SEA—*Shipwreck for Insurance—Life Less Esteemed than Property.*—There is no doctrine in physics more certainly true than this doctrine in politics—that every practise which the authority of society recognizes or supports has its own train of consequences which, for evil or for good, can be modified or changed in an infinite variety of degrees according as that sanction is given or withheld. . . . Thus, for example, there seems good reason to believe there is a direct relation between the amount of life and property annually sacrificed by shipwreck, and the legislation which recognizes and sanctions insurance to the full amount of the value of ship and cargo. The cause of this is obvious. Care for life is less eager and less wakeful than care for property. This is true even when men are dealing equally with their own property and with their own lives. It is still more true when they are dealing not only with property which is their own, but with lives which belong to others. The inevitable effect of such insurance is therefore to relax the motives of self-interest, which are the strongest incitements to precaution.—ARGYLL *Reign of Law*, ch. 7, p. 217. (Burt.)

3059. SELF-SACRIFICE OF A FLOWER—*Laying Down Life for Offspring—Struggle for the Life of Others.*—Watch this flower at work for a little, and behold a miracle. Instead of struggling for life, it lays down its life. After clothing itself with a beauty which is itself the minister of unselfishness, it droops, it wastes, it lays down its life. The tree still lives; the other leaves are fresh and green; but this life within a life is dead. And why? Because within this death is life. Search among the withered petals, and there, in a cradle of cunning workmanship, are a hidden progeny of clustering seeds — the gift to the future which this dying mother has brought into the world at the cost of leaving it. The food she might have lived upon is given to her children, stored round each tiny embryo with lavish care, so that when they waken into the world the first helplessness of their hunger is met. All the arrangements in plant life which concern the flower, the fruit, and the seed are the creations of the struggle for the life of others.—DRUMMOND *Ascent of Man*, p. 227. (J. P., 1900.)

3060. SENSATION REQUIRES TIME FOR TRANSMISSION—*Whale Not Instantly Aware of Wound.*—People in general imagine, when they think at all about the matter, that an impression upon the nerves —a blow, for example, or the prick of a pin —is felt at the moment it is inflicted. But this is not the case. The seat of sensation being the brain, to it the intelligence of any impression made upon the nerves has to be transmitted before this impression can become manifest as consciousness. The transmission, moreover, requires time, and the consequence is that a wound inflicted on a portion of the body distant from the brain is more tardily appreciated than one inflicted adjacent to the brain. By an extremely ingenious experimental arrangement, Helmholtz has determined the velocity of this nervous transmission, and finds it to be about eighty feet a second, or less than one-thirteenth of the velocity of sound in air. If, therefore, a whale forty feet long were wounded in the tail, it would not be conscious of the injury till half a second after the wound had been inflicted.—TYNDALL *Fragments of Science*, vol. i, ch. 21, p. 439. (A.)

3061. SENSATIONS ACUTE OR MASSIVE—*Touch, Light, Sound—Acuteness vs. Diffusion of Sensation.*—There is an interesting correspondence between the physical and the mental, in regard to a marked distinction among the sensations, in all the senses, between the acute and the voluminous or massive. A sharp prick in the finger, or a hot cinder, yields acute sensations; the contact of the clothing of the entire body, or a warm bath, yields voluminous or massive sensations. Now it is observable that an acute sensation is due to an intense stimulus on a small surface; a massive sensation, to a gentler stimulus over an extended surface. The contrast is noticeable in every one of the senses. A gas flame gives an acute feeling, the diffused sunlight gives a massive feeling. A high note upon the flageolet is acute; a deep bass note on the violoncello or the organ is massive. The sea, the thunder, the shouting of a multitude are voluminous or massive from repetition over a wide area. Taste is acute, digestive feeling is massive. Thus thoroughly does the mere manner of external incidence determine one of the most notable distinctions among our states of feeling.—BAIN *Mind and Body*, ch. 3, p. 11. (Hum., 1880.)

3062. SENSATIONS INCREASED BY ATTENTION—*Unnatural Sensitiveness in Hysteria.*—It is no less certain, however, that the intensity of sensations is greatly affected by the degree in which the recipient mind is directed towards them; and this

may operate in regard either to sensory impressions generally or to those of some particular class. Of the former we have a characteristic example in what is known as the hysterical condition; in which the patient's attention is so fixed upon her own bodily state that the most trivial impressions are magnified into severe pains; while there is often such an extraordinary acuteness to sounds that she overhears a conversation carried on in an undertone in an adjoining room, or (as in a case known to the writer) in a room on the second floor beneath. There is here, doubtless, a peculiar physical susceptibility to nervous impressions, which is to a certain degree remediable by medical treatment; but much depends upon the diversion of the patient's attention from her own fancied ailments, and we here see the importance of the self-determining power of the will, which, if duly exercised, can substitute a healthful direction of the mental activity for the morbid imaginings to which the patient has previously yielded herself.—CARPENTER *Nature and Man*, bk. i, ch. 4, p. 153. (A., 1900.)

3063. SENSATIONS NOT TO BE MEASURED NUMERICALLY—The whole notion of measuring sensations numerically remains in short a mere mathematical speculation about possibilities, which has never been applied to practise.—JAMES *Psychology*, vol. i, ch. 13, p. 539. (H. H. & Co., 1899.)

3064. SENSATIONS OF NORMAL CONSCIOUSNESS TO BE TRUSTED—*Some External Fact Corresponds.*—The physicist, by reducing all external changes to "modes of motion," appears to leave no room in his world-mechanism for the secondary qualities of bodies, such as light and heat, as popularly conceived. Yet, while allowing this, I think we may still regard the attribution of qualities like color to objects as in the main correct and answering to a real fact. When a person says an object is red, he is understood by everybody as affirming something which is true or false, something, therefore, which either involves an external fact or is illusory. It would involve an external fact whenever the particular sensation which he receives is the result of a physical action (ether vibrations of a certain order), which would produce a like sensation in anybody else in the same situation and endowed with the normal retinal sensibility. On the other hand, an illusory attribution of color would imply that there is no corresponding physical agency at work in the case, but that the sensation is connected with exceptional individual conditions, as, for example, altered retinal sensibility.—SULLY *Illusions*, ch. 3, p. 36. (A., 1897.)

3065. SENSE OF BEAUTY, SCIENCE DOES NOT DIMINISH—*Knowledge Not Incompatible with Poetry.*—Does the knowledge of the fact that oxygen has been discovered in the sun tend to diminish by one iota the feeling of joy, the inexpressible sense of delight and wonder, with which we see the red rays rising aslant over the Rigi, and finally bursting into glorious effulgence as peak after peak is tinged with the morning glow? Or when we walk abroad in the full glow of the midday, does the idea of the immensity of heaven's great orb, the knowledge of its distance from us, or the information which details the extent of time occupied in the transit of its light-rays earthward interfere in any sense with our delight in the poetry which has selected astronomy as its theme? Does such knowledge repress what Dr. Shairp would call "the momentary elevation of heart," for which its subject "has no words"? The eye rests on the grateful green of Nature which everywhere meets our gaze, and drinks in the sense of beauty and of this earth's sweet fairness. Shall I the less be filled with joy because I know that the green is the botanist's "chlorophyl," and that but for the verdant hues of plants our world would become a great stagnant pond of foul air?—ANDREW WILSON *Science and Poetry*, p. 8. (Hum., 1888.)

3066. SENSE OF DURATION—*Perception of Empty Time Vast and Dreary—Slow Lapse of a Minute.*—Close your eyes and simply wait to hear somebody tell you that a minute has elapsed. The full length of your leisure with it seems incredible. You engulf yourself into its bowels as into those of that interminable first week of an ocean voyage, and find yourself wondering that history can have overcome many such periods in its course, all because you attend so closely to the mere feeling of the time *per se*, and because your attention to that is susceptible of such fine-grained, successive subdivision. The odiousness of the whole experience comes from its insipidity; for stimulation is the indispensable requisite for pleasure in an experience, and the feeling of bare time is the least stimulating experience we can have.—JAMES *Psychology*, vol. i, ch. 15, p. 626. (H. H. & Co., 1899.)

3067. SENSE OF IGNORANCE A LAW OF MAN'S BEING—*Origin of Curiosity and Wonder—Incentive to Progress.*—It is impossible to mistake, then, the place which is occupied among the unities of Nature by that sense of ignorance which is universal among men. It belongs to the number of those primary mental conditions which impel all living things to do that which it is their special work to do, and in the doing of which the highest law of their being is fulfilled. In the case of the lower animals this law, as to the part they have to play, and the ends they have to serve in the economy of the world, is simple, definite, and always perfectly attained. No advance is with them possible, no capacity

of improvement, no dormant or undeveloped powers leading up to wider and wider spheres of action. With man, on the contrary, the law of his being is a law which demands progress, which endows him with faculties enabling him to make it, and fills him with aspirations which cause him to desire it. Among the lowest savages there is some curiosity and some sense of wonder, else even the rude inventions they have achieved would never have been made, and their degraded superstitions would not have kept their hold. Man's sense of ignorance is one of the greatest of his gifts, for it is the secret of his wish to know. The whole structure and the whole furniture of his mind are adapted to this condition. The highest law of his being is to advance in wisdom and knowledge, and his sense of the presence and of the power of things which he can only partially understand is an abiding witness of this law, and an abiding incentive to its fulfilment.—ARGYLL *Unity of Nature*, ch. 9, p. 189. (Burt.)

3068. SENSE OF PROPERTY MANIFESTED BY DOGS—Dogs seem to have the feeling of the value of their master's personal property, or at least a particular interest in objects which their master uses. A dog left with his master's coat will defend it, tho never taught to do so. I know of a dog accustomed to swim after sticks in the water, but who always refused to dive for stones. Nevertheless, when a fish-basket, which he had never been trained to carry, but merely knew as his master's, fell over, he immediately dived after it and brought it up. Dogs thus discern, at any rate so far as to be able to act, this partial character of being valuable, which lies hidden in certain things.—JAMES *Psychology*, vol. ii, ch. 22, p. 350. (H. H. & Co., 1899.)

3069. SENSE-IMPRESSIONS, COMBINATION AND INTERPRETATION OF—*Attention of Infant Is Automatic.*—In the young child, as among the lower animals, the attention seems purely automatic, being solely determined by the attractiveness of the object: and the diversion of it from one object to another simply depends upon the relative force of the two attractions. It is this automatic fixation of the attention on the sense-impressions received from the external world that enables the infant to effect that marvelous combination of visual and tactile perceptions which guides the whole subsequent interpretation of its phenomena. . . . When an attractive object is presented to it, which it grasps in its little hands, carries to its lips, and holds at different distances, earnestly gazing at it all the while, it is learning a most valuable lesson, and the judicious mother or nurse will not interrupt this process, but will allow the infant to go on with its examination of the object as long as it is so disposed.—CARPENTER *Mental Physiology*, ch. 3, p. 133. (A., 1900.)

3070. SENSE-PERCEPTIONS ACT ONE AT A TIME—*Sight and Hearing among Astronomers.*—Astronomers have long been aware that no human being can hear and see at the same time. If a moving star is being observed through a telescope, and the observer is required to announce, while counting the strokes of a pendulum, at which stroke the star is found at a certain point, he never fails to make a mistake. He generally counts one too many strokes of the pendulum. He sees first and then hears. —PREYER *Ueber Empfindungen (a Lecture).* (Translated for *Scientific Side-Lights.)*

3071. SENSES, ASSUMED "FALLACY" OF—*Intellectual Fallacy by Erroneous Inference.*—Note that in every illusion what is false is what is inferred, not what is immediately given. The "this," if it were felt by itself alone, would be all right; it only becomes misleading by what it suggests. If it is a sensation of sight, it may suggest a tactile object, for example, which later tactile experiences prove to be not there. The so-called "fallacy of the senses," of which the ancient skeptics made so much account, is not fallacy of the senses proper, but rather of the intellect, which interprets wrongly what the senses give.—JAMES *Psychology*, vol. ii, ch. 19, p. 86. (H. H. & Co., 1899.)

3072. SENSES IN CONFLICT—*Vision on Precipice Opposed to Muscular Sense of Equilibrium—Resultant Feeling of Insecurity.*—Thus a person unaccustomed to look down heights feels insecure at the top of a tower or a precipice, altho he knows that his body is properly supported, for the void which he sees below him contradicts (as it were) the muscular sense by which he is made conscious of its due equilibrium. So, again, altho any one can walk along a narrow plank which forms part of the floor of a room, or which is elevated but little above it, without the least difficulty, and even without any consciousness of effort, yet if that plank be laid across a chasm the bottom of which is so far removed from the eye that the visual sense gives no assistance, even those who have braced their nerves against all emotional distraction feel that an effort is requisite to maintain the equilibrium during their passage over it, that effort being aided by the withdrawal of the eyes from the depth below, and the fixation of them on a point beyond, which at the same time helps to give steadiness to the movements and distracts the mind from the sense of its danger.—CARPENTER *Mental Physiology*, bk. i, ch. 5, p. 214. (A., 1900.)

3073. SENSES, JUDGMENT NEEDED TO INTERPRET—The question whether vermilion is really red as we see it, or whether that is only a delusion of our sense, is therefore unmeaning. The sensation of red is the normal reaction from the light reflected from vermilion upon normally constructed

eyes. One who is red-blind would see the vermilion black or a dark grayish yellow; that also is the correct reaction for his peculiar construction of eye. But he ought to be aware that his eyes differ from those of other human beings. In itself the one sensation is neither more correct nor more false than the other, altho the red-seeing are in the majority. In fact, the red color of vermilion only has existence in as far as there are eyes constructed like the majority of eyes. It is absolutely as much a characteristic of vermilion to be black, namely, for the red-blind. The fact is, the light reflected from vermilion is not to be termed red *per se;* it is only red for eyes of a peculiar form. . . . It would seem as if it were unnecessary to mention this, and for that reason we are apt to forget it, and to be deceived into believing that the red is a characteristic belonging to vermilion, or to the light reflected from it, wholly independent of our organs of sight. It is different when we assert that the waves thrown back from vermilion have a certain length. That is an assertion we can make independent of the peculiar nature of our eyes; it is wholly a question of the relations between the substance and the different systems of the waves of ether.—HELMHOLTZ *Handbuch der physiologischen Optik*, p. 589. (Translated for *Scientific Side-Lights.)*

3074. SENSES, KEENNESS OF, AMONG RUDE TRIBES—*Wonderful Skill and Judgment of Savage Hunter.*—The natives of the Brazilian forests, to whom tracking game is the chief business of life, do it with a skill that fills with wonder the white men who have watched them. The Botocudo hunter, gliding stealthily through the underwood, knows every habit and sign of bird and beast; the remains of berries and pods show him what creature has fed there; he knows how high up an armadillo displaces the leaves in passing, and so can distinguish its track from the snake's or tortoise's, and follow it to its burrow by the scratches of its scaly armor on the mud. Even the sense of smell of this savage hunter is keen enough to help him in tracking. Hidden behind the trunk of a tree, he can imitate the cries of birds and beasts to bring them within range of his deadly poisoned arrow, and he will even entice the alligator by making her rough eggs grate together where they lie under leaves on the river-bank. If an ape he has shot high in the boughs of some immense tree remains hanging by its tail, he will go up after it by a hanging creeper where no white man would climb. At last, laden with game and useful forest things, such as palm-fiber to make hammocks, or fruit to brew liquor, he finds his way back to his hut by the sun and the lie of the ground, and the twigs that he bent back for way-marks as he crept through the thicket.—TYLOR *Anthropology*, ch. 9, p. 207. (A., 1899.)

3075. SENSES, RELATIVE ACUTENESS OF—*Keenness of Scent among Arabs.*—It is said that the Arabs of the Sahara can recognize the smell of a fire thirty or forty miles distant.—CARPENTER *Mental Physiology*, bk. i, ch. 3, p. 141. (A., 1900.)

3076. ——— *Keenness of Scent among Indians.*—We are told by Humboldt that the Peruvian Indians in the darkest night can not merely perceive through their scent the approach of a stranger whilst yet far distant, but can say whether he is an Indian, European, or negro.—CARPENTER *Mental Physiology*, bk. i, ch. 3, p. 141. (A., 1900.)

3077. ——— *Progress Accompanied by Decline—Smell of First Importance to Lower Animals—Little Used by Man.*—In general, this lowest, most animal, least intellectual of the sensations [smell] is peculiarly baffling of all attempts to reduce it to terms of science. In the developed and cultivated human species smell has come to be, for the most part, of the nature of an esthetical advantage or affliction, rather than a means of accurate knowledge. But in the lower and less cultivated phases of animal life it, by the prompt and accurate information it furnishes, serves as a most important factor in the preservation, propagation, and evolution of the individual and of the species.—LADD *Psychology*, ch. 6, p. 100. (S., 1899.)

3078. SENSES, TO EXTEND THEIR RANGE ONE OF THE PROBLEMS OF SCIENCE—*Telescope and Microscope.*—One of the problems of science, on which scientific progress mainly depends, is to help the senses of man by carrying them into regions which could never be attained without such help. Thus we arm the eye with the telescope when we want to sound the depths of space, and with the microscope when we want to explore motion and structure in their infinitesimal dimensions.—TYNDALL *Lectures on Light*, lect. 1, p. 12. (A., 1898.)

3079. SENSIBILITY CHANGEABLE—*The World Enduring.*—There are facts which make us believe that our sensibility is altering all the time, so that the same object cannot easily give us the same sensation over again. The eye's sensibility to light is at its maximum when the eye is first exposed, and blunts itself with surprising rapidity. A long night's sleep will make it see things twice as brightly on wakening, as simple rest by closure will make it see them later in the day. We feel things differently according as we are sleepy or awake, hungry or full, fresh or tired; differently at night and in the morning; differently in summer and in winter; and, above all things, differently in childhood, manhood, and old age. Yet we never doubt that our feelings reveal the same world, with the same sensible qualities and the same sensible things occupying it.—JAMES *Psychology*, vol. i, ch. 9, p. 232. (H. H. & Co., 1899.)

3080. SENSITIVENESS OF PLANTS TO LIGHT—*Exactness of Movement.*—In our various experiments we were often struck with the accuracy with which seedlings pointed to a light, altho of small size. To test this, many seedlings of *Phalaris*, which had germinated in darkness in a very narrow box several feet in length, were placed in a darkened room near to and in front of a lamp having a small cylindrical wick. The cotyledons at the two ends and in the central part of the box would therefore have to bend in widely different directions in order to point to the light. After they had become rectangularly bent, a long white thread was stretched by two persons, close over and parallel, first to one and then to another cotyledon, and the thread was found in almost every case actually to intersect the small circular wick of the now extinguished lamp. The deviation from accuracy never exceeded, as far as we could judge, a degree or two.—DARWIN *Power of Movement in Plants*, ch. 9, p. 469. (A., 1900.)

3081. SENSITIVENESS SPECIALIZED—*Leaves of Dionæa Close at Touch of Insect—Wind and Rain Have No Effect.*—Drops of water, or a thin, broken stream, falling from a height on the filaments, did not cause the blades to close, tho these filaments were afterwards proved to be highly sensitive. No doubt, as in the case of *Drosera*, the plant is indifferent to the heaviest shower of rain. Drops of a solution of a half an ounce of sugar to a fluid ounce of water were repeatedly allowed to fall from a height on the filaments, but produced no effect, unless they adhered to them. Again, I blew many times through a fine-pointed tube with my utmost force against the filaments without any effect, such blowing being received with as much indifference as no doubt is a heavy gale of wind. We thus see that the sensitiveness of the filaments is of a specialized nature, being related to a momentary touch rather than to prolonged pressure; and the touch must not be from fluids, such as air or water, but from some solid object.—DARWIN *Insectivorous Plants*, ch. 13, p. 236. (A., 1900.)

3082. SENTIMENT WITHOUT ACTION PERNICIOUS—*Character Hopelessly Enervated.*—No matter how full a reservoir of maxims one may possess, and no matter how good one's sentiments may be, if one have not taken advantage of every concrete opportunity to act, one's character may remain entirely unaffected for the better. . . . A tendency to act only becomes effectively ingrained in us in proportion to the uninterrupted frequency with which the actions actually occur, and the brain "grows" to their use. Every time a resolve or a fine glow of feeling evaporates without bearing practical fruit is worse than a chance lost; it works so as positively to hinder future resolutions and emotions from taking the normal path of discharge. There is no more contemptible type of human character than that of the nerveless sentimentalist and dreamer, who spends his life in a weltering sea of sensibility and emotion, but who never does a manly, concrete deed. Rousseau, inflaming all the mothers of France by his eloquence, to follow Nature and nurse their babies themselves, while he sends his own children to the foundling hospital, is the classical example of what I mean.—JAMES *Psychology*, vol. i, ch. 4, p. 125. (H. H. & Co., 1899.)

3083. SEPARATENESS OF GREAT SUBKINGDOMS OF ANIMALS—*"Missing Links" Not Found—No Transitional Forms Known in Present or Past.*—If I had followed out all these various lines of classification fully I should discover in the end that there was no animal, either recent or fossil, which did not at once fall into one or other of these subkingdoms. In other words, every animal is organized upon one or other of the five or more plans whose existence renders our classification possible. And so definitely and precisely, marked is the structure of each animal that, in the present state of our knowledge, there is not the least evidence to prove that a form, in the slightest degree transitional between any two of the groups *Vertebrata, Annulosa, Mollusca*, and *Cœlenterata*, either exists, or has existed, during that period of the earth's history which is recorded by the geologist.—HUXLEY *Lay Sermons*, vol. vi, p. 103. (A., 1895.)

3084. SERVICE OF AMATEURS—*Schwabe, a German Magistrate, Takes to Counting Sun-spots—Important Law Discovered.*—The sun sometimes has numerous spots on it, and sometimes none at all; but it does not seem to have occurred to any one to see whether they had any regular period for coming or going, till Schwabe, a magistrate in a little German town, who happened to have a small telescope and a good deal of leisure, began for his own amusement to note their number every day. He commenced in 1826, and with German patience observed daily for forty years. He first found that the spots grew more numerous in 1830, when there was no single day without one; then the number declined very rapidly, till in 1833 they were about gone; then they increased in number again till 1838, then again declined; and so on, till it became evident that sun-spots do not come and go by chance, but run through a cycle of growth and disappearance, on the average about once in every eleven years.—LANGLEY *New Astronomy*, ch. 1, p. 77. (H. M. & Co.)

3085. SERVICE OF GREAT TO SMALL—*"Whosoever Will Be Chief among You, Let Him Be Your Servant" (Matt. xxi, 27)—Saturn a Minor Sun to His Satellites.*—We seem compelled, then, to adopt the view that Saturn subserves useful purposes to

the worlds which circle round him. To these he certainly supplies much reflected light, and possibly a considerable proportion of inherent light. He probably warms them in a much greater degree. And it seems no unworthy thought respecting him that even as he sways them by his attractive energy, so he nourishes them as a subordinate sun by the heat with which his great mass is instinct. If our sun, so far surpassing all his dependent worlds in mass, yet acts as their servant in such respects, we may reasonably believe that Saturn and Jupiter act a similar part towards the orbs which circle round them.—PROCTOR *Expanse of Heaven*, p. 103. (L. G. & Co., 1897.)

3086. SERVICE, RECIPROCAL, OF PLANTS AND ANIMALS—Plant life seizes upon its required constituents, and by means of the energy furnished by the sun's rays builds these materials up into its own complex forms. Its many and varied forms fulfil a place in beautifying the world. But their contribution to the economy of Nature is, by means of their products, to supply food for animal life. The products of plant life are chiefly sugar, starch, fat, and proteids. Animal life is not capable of extracting its nutriment from soil, but it must take the more complex foods which have already been built up by vegetable life. Again, the complementary functions of animal and vegetable life are seen in the absorption by plants of one of the waste materials of animals, viz., carbonic acid gas. Plants abstract from this gas carbon for their own use, and return the oxygen to the air, which in turn is of service to animal life.—NEWMAN *Bacteria*, ch. 5, p. 147. (G. P. P., 1899.)

3087. "SETTING" OF THE MEMORY—*Learning in Order to Forget—Religion and Morality May Be Limited to Times and Seasons.*—There is an interesting fact connected with remembering, which, so far as I know, Mr. R. Verdon was the first writer expressly to call attention to. We can set our memory as it were to retain things for a certain time, and then let them depart.

"Individuals often remember clearly and well up to the time when they have to use their knowledge, and then, when it is no longer required, there follows a rapid and extensive decay of the traces. Many schoolboys forget their lessons after they have said them, many barristers forget details got up for a particular case. Thus a boy learns thirty lines of Homer, says them perfectly, and then forgets them so that he could not say five consecutive lines the next morning, and a barrister may be one week learned in the mysteries of making cogwheels, but in the next he may be well acquainted with the anatomy of the ribs instead."

The rationale of this fact is obscure, and the existence of it ought to make us feel how truly subtle are the nervous processes which memory involves.—JAMES *Psychology*, vol. i, ch. 16, p. 685. (H. H. & Co., 1899.)

3088. SEVERITY AND PRIVATION OF THE NORTH—*Mental Triumph a Compensation.*—Many of the enjoyments which Nature affords are denied to the nations of the North. Many constellations and many vegetable forms, including more especially the most beautiful productions of the earth (palms, tree-ferns, bananas, arborescent grasses, and delicately feathered mimosas), remain forever unknown to them; for the puny plants pent up in our hothouses give but a faint idea of the majestic vegetation of the tropics. But the rich development of our language, the glowing fancy of the poet, and the imitative art of the painter, afford us abundant compensation; and enable the imagination to depict in vivid colors the images of an exotic Nature. In the frigid North, amid barren heaths, the solitary student may appropriate all that has been discovered in the most remote regions of the earth, and thus create within himself a world as free and imperishable as the spirit from which it emanates.—HUMBOLDT *Views of Nature*, p. 231. (Bell, 1896.)

3089. SEWING AMONG SAVAGES—*Needles in the Stone Age—New Zealanders Drill Hole in Glass.*—The neatness with which the Hottentots, Eskimos, North-American Indians, etc., are able to sew, is very remarkable, altho awls and sinews would in our hands be but poor substitutes for needles and thread. . . . Some cautious archeologists hesitated to refer the reindeer caves of the Dordogne to the Stone Age, on account of the bone needles and the works of art which are found in them. The eyes of the needles especially, they thought, could only be made with metallic implements. Professor Lartet ingeniously removed these doubts by making a similar needle for himself with the help of a flint: but he might have referred to the fact stated by Cook in his first voyage, that the New Zealanders succeeded in drilling a hole through a piece of glass which he had given them, using for this purpose, as he supposed, a piece of jasper.—AVEBURY *Prehistoric Times*, ch. 15, p. 523. (A., 1900.)

3090. SEWING OF PRIMITIVE WOMAN—Plain sewing among the lowest peoples is an affair of the skin dresser. They do not, as has been said, make cloth in long pieces to be cut up and sewed into garments and other useful things. This being the fact, the best tailors ought to be sought in the arctic regions. And this is true, as any one knows who has examined the garments of caribou skin, of sealskin, of the pelts of the little fur-bearing animals, of the intestines of the larger mammals, wrought by the Siberians and the Eskimo.

Parkas or blouses, trousers or boots, are

cut out with stone or metal knives. The edges of the parts are whipped together with sinews so as to be water-tight. Bits of different colored fur are inserted for ornamentation, and, frequently, to save every scrap, the sempstress will have a hundred pieces of skin in a single garment. Her needle is a tough bit of bone working like an awl, and her sinew is drawn through with a true needle made of bird-bone. Her thimble is a bit of tough seal hide drawn over the end of the forefinger, tho in modern times they imitate in ivory the white woman's thimble.—MASON *Origins of Invention*, ch. 7, p. 248. (S., 1899.)

3091. SEX AND DIVISION OF LABOR—*Woman the Inventor of the Arts of Peace.*—Division of labor began with the invention of fire-making, and it was a division of labor based upon sex. The woman stayed by the fire to keep it alive, while the man went to the field or the forest for game. The world's industrialism and militancy began then and there. Man has been cunning in devising means of killing beast and his fellow man—he has been the inventor in every murderous art. The woman at the fireside became the burden-bearer, the basket-maker, the weaver, potter, agriculturist, domesticator of animals—in a word, the inventor of all the peaceful arts of life.—MASON *Woman's Share in Primitive Culture*, pref., p. 7. (A., 1894.)

3092. SEX BINDS UNITS INTO UNITY—*Separates in Order to Unite—God Setteth the Solitary in Families (Ps. lxviii, 6).*—By a device the most subtle of all that guard the higher evolution of the world—the device of sex—Nature accomplishes this task of throwing irresistible bonds around widely separate things, and establishing such sympathies between them that they must act together or forfeit the very life of their kind. Sex is a paradox; it is that which separates in order to unite. The same mysterious mesh which Nature threw over the two separate palms, she threw over the few and scattered units which were to form the nucleus of mankind.—DRUMMOND *Ascent of Man*, ch. 7, p. 243. (J. P., 1900.)

3093, SEX, DIFFERENTIATION OF, FROM CELL TO SOUL—*Energy, Motion, Activity of Male—Passivity, Gentleness, Repose of Female.*—The predominating note in the male will be energy, motion, activity; while passivity, gentleness, repose, will characterize the female. These words, let it be noticed, psychical tho they seem, are yet here the coinages of physiology. No other terms indeed would describe the difference. Thus Geddes and Thomson: "The female cochineal insect, laden with reserve products in the form of the well-known pigment, spends much of its life like a mere quiescent gall on the cactus plant. The male, on the other hand, in his adult state, is agile, restless, and short-lived. Now this is no mere curiosity of the entomologist, but in reality a vivid emblem of what is an average truth throughout the world of animals—the preponderating passivity of the females, the freedomness and activity of the males." Rolph's words, because he writes neither of men nor of animals, but goes back to the furthest recess of Nature and characterizes the cell itself, are still more significant: "The less nutritive and therefore smaller, hungrier, and more mobile organism is the male; the more nutritive and usually more quiescent is the female."—DRUMMOND *Ascent of Man*, ch. 7, p. 255. (J. P., 1900.)

3094. "SEX OF SOUL"—*Inherent Differences in Mental Activity of Man and Woman.*—It has been affirmed by some philosophers that there is no essential difference between the mind of a woman and that of a man, and that if a girl were subjected to the same education as a boy she would resemble him in tastes, feelings, pursuits, and powers. To my mind it would not be one whit more absurd to affirm that the antlers of the stag, the human beard, and the cock's comb, are effects of education. . . . The physical and mental differences between the sexes intimate themselves very early in life, and declare themselves most distinctly at puberty. . . . While woman preserves her sex, she will necessarily be feebler than man, and, having her special bodily and mental characters, will have to a certain extent her own sphere of activity; where she has become thoroughly masculine in nature, or hermaphrodite in mind—when, in fact, she has pretty well divested herself of her sex—then she may take his ground, and do his work; but she will have lost her feminine attractions, and probably also her chief feminine functions.—MAUDSLEY *Body and Mind*, lect. 1, p. 35. (A., 1898.)

3095. SHADOW SEEMING SUBSTANCE—*A Terrifying Spectacle—Movement of Moon's Shadow across the Earth in Solar Eclipse—Real Confounded with Apparent Motion.*—The reader who has ever ascended to the Superga, at Turin, will recall the magnificent view, and be able to understand the good fortune of an observer (Forbes) who once had the opportunity to witness thence this phenomenon, and under a nearly cloudless sky. "I perceived," he says, "in the southwest a black shadow like that of a storm about to break, which obscured the Alps. It was the lunar shadow coming towards us." And he speaks of the "stupefaction"—it is his word—caused by the spectacle. "I confess," he continues, "it was the most terrifying sight I ever saw. As always happens in the case of sudden, silent, unexpected movements, the spectator confounds real and relative motion. I felt almost giddy for a moment, as tho the massive building under me bowed on the coming eclipse." Another witness, who had been looking at some bright clouds just before, says: "The bright cloud I saw distinctly

put out like a candle. The rapidity of the shadow, and the intensity, produced a feeling that something material was sweeping over the earth at a speed perfectly frightful. I involuntarily listened for the rushing noise of a mighty wind."—LANGLEY *New Astronomy*, ch. 2, p. 38. (H. M. & Co.)

3096. SHELLS, IMPORTANCE OF, IN CHRONOLOGY—*The Medals of Nature.*—In the present state of science, it is chiefly by the aid of shells that we are enabled to arrive at these results [determination of geological time], for of all classes the *Testacea* are the most generally diffused in a fossil state, and may be called the medals principally employed by Nature in recording the chronology of past events.—LYELL *Principles of Geology*, bk. i, ch. 13, p. 183. (A. 1854.)

3097. SHELLS, POMPEIAN, UNCHANGED THROUGH CENTURIES—*Pictures Preserved—Lines Written by Vanished Hands—Enduring Record of the Evanescent.*—The writings scribbled by the soldiers on the walls of their barracks [at Pompeii], and the names of the owners of each house written over the doors, are still perfectly legible. The colors of fresco paintings on the stuccoed walls in the interior of buildings are almost as vivid as if they were just finished. There are public fountains decorated with shells laid out in patterns in the same fashion as those now seen in the town of Naples; and in the room of a painter, who was perhaps a naturalist, a large collection of shells was found, comprising a great variety of Mediterranean species, in as good a state of preservation as if they had remained for the same number of years in a museum. A comparison of these remains with those found so generally in a fossil state would not assist us in obtaining the least insight into the time required to produce a certain degree of decomposition or mineralization; for, altho under favorable circumstances much greater alteration might doubtless have been brought about in a shorter period, yet the example before us shows that an inhumation of seventeen centuries may sometimes effect nothing towards the reduction of shells to the state in which fossils are usually found.—LYELL *Principles of Geology*, bk. ii, ch. 24, p. 392. (A., 1854.)

3098. SHOCK, TRANSMITTED—*Earthquake Heaves Ocean Wave on the Shore.*—Shortly after the shock [of the Chilean earthquake of 1835], a great wave was seen from the distance of three or four miles, approaching in the middle of the bay with a smooth outline; but along the shore it tore up cottages and trees, as it swept onwards with irresistible force. At the head of the bay it broke in a fearful line of white breakers, which rushed up to a height of 23 vertical feet above the highest spring-tides. Their force must have been prodigious, for at the fort a cannon with its carriage, estimated at four tons in weight, was moved 15 feet inwards. A schooner was left in the midst of the ruins, 200 yards from the beach. The first wave was followed by two others, which in their retreat carried away a vast wreck of floating objects. . . . The great wave must have traveled slowly, for the inhabitants of Talcahuano had time to run up the hills behind the town; and some sailors pulled out seaward, trusting successfully to their boat riding securely over the swell, if they could reach it before it broke.—DARWIN *Naturalist's Voyage around the World*, ch. 14, p. 305. (A., 1898.)

3099. ——— ——— *Wide Reach of Earthquake of Lisbon—Felt Over Half the World—Mighty Wave in West Indies.*—The area over which this convulsion [the earthquake of Lisbon] extended is very remarkable. It has been computed, says Humboldt, that on the 1st [of] November, 1755, a portion of the earth's surface four times greater than the extent of Europe was simultaneously shaken. The shock was felt in the Alps and on the coast of Sweden, in small inland lakes on the shores of the Baltic, in Thuringia, and in the flat country of northern Germany. The thermal springs of Toplitz dried up, and again returned, inundating everything with water discolored by ocher. In the islands of Antigua, Barbadoes, and Martinique, in the West Indies, where the tide usually rises little more than two feet, it suddenly rose above twenty feet, the water being discolored and of an inky blackness. The movement was also sensible in the great lakes of Canada. At Algiers and Fez, in the north of Africa, the agitation of the earth was as violent as in Spain and Portugal; and at the distance of eight leagues from Morocco, a village with the inhabitants to the number of about 8,000 or 10,000 persons, are said to have been swallowed up, the earth soon afterwards closing over them.—LYELL *Principles of Geology*, bk. ii, ch. 29, p. 495. (A., 1854.)

3100. SHORE, INHOSPITABLE—*Insects Blown Far Out to Sea Off Patagonia.*—When seventeen miles off Cape Corrientes, I had a net overboard to catch pelagic animals. Upon drawing it up, to my surprise I found a considerable number of beetles in it, and altho in the open sea, they did not appear much injured by the salt water. . . . At first I thought that these insects had been blown from the shore: but upon reflecting that out of the eight species four were aquatic, and two others partly so in their habits, it appeared to me most probable that they were floated into the sea by a small stream which drains a lake near Cape Corrientes. On any supposition it is an interesting circumstance to find live insects swimming in the open ocean seventeen miles from the nearest point of land. There are several accounts of insects having been blown off the Patagonian shore. Captain Cook observed it, as did more lately

Captain King in the "Adventure." The cause probably is due to the want of shelter, both of trees and hills, so that an insect on the wing, with an off-shore breeze, would be very apt to be blown out to sea.—DARWIN *Naturalist's Voyage around the World*, ch. 8, p. 160. (A., 1898.)

3101. SHOWER OF VOLCANIC ASHES—*Cattle Overwhelmed in Fiery Deluge—Modern Catastrophe Throws Light on Geologic Past.*—The great crest or cordillera of the Andes is depressed at the Isthmus of Panama to a height of about 1,000 feet, and at the lowest point of separation between the two seas near the Gulf of San Miguel to 150 feet. What some geographers regard as a continuation of that chain in Central America lies to the east of a series of volcanoes, many of which are active in the provinces of Pasto, Popayan, and Guatemala. Coseguina, on the south side of the Gulf of Fonseca, was in eruption in January, 1835, and some of its ashes fell at Truxillo, on the shores of the Gulf of Mexico. What is still more remarkable, on the same day, at Kingston, in Jamaica, the same shower of ashes fell, having been carried by an upper counter-current against the regular east wind which was then blowing. Kingston is about 700 miles distant from Coseguina, and these ashes must have been more than four days in the air, having traveled 170 miles a day. Eight leagues to the southward of the crater the ashes covered the ground to the depth of three yards and a half, destroying the woods and dwellings. Thousands of cattle perished, their bodies being in many instances one mass of scorched flesh. Deer and other wild animals sought the towns for protection; many birds and quadrupeds were found suffocated in the ashes, and the neighboring streams were strewed with dead fish. Such facts throw light on geological monuments, for in the ashes thrown out at remote periods from the volcanoes of Auvergne, now extinct, we find the bones and skeletons of lost species of quadrupeds.—LYELL *Principles of Geology*, bk. ii, ch. 22, p. 349. (A., 1854.)

3102. SIGHT AND TOUCH NOT EQUIVALENT—*Recovery from Blindness.*—In regard to our visual conceptions it may be stated with perfect certainty, as the result of very numerous observations made upon persons who have acquired sight for the first time, that these do not serve for the recognition even of those objects with which the individual had become most familiar through the touch, until the two sets of sense-perceptions have been coordinated by experience. . . .

Thus, in a recently recorded case, in which sight was imparted by operation to a young woman who had been blind from birth, but who had nevertheless learned to work well with her needle, when the pair of scissors she had been accustomed to use was placed before her, tho she described their shape, color, and glistening metallic character, she was utterly unable to recognize them as scissors until she put her finger on them, when she at once named them, laughing at her own stupidity (as she called it) in not having made them out before.—CARPENTER *Nature and Man*, lect. 6, p. 201. (A., 1889.)

3103. SIGHT NOT EXPLAINED BY MECHANISM ONLY—*Material Science Cannot Account for Consciousness, Mind, Life.*—[In comparing the camera with the eye, we find a close likeness up to a certain point. Mechanism, physics, and chemistry explain the production of the image in both. But suddenly the likeness disappears. There is something in vision that mechanism, physics, and chemistry cannot explain.] At a certain point molecular and chemical change is replaced by sensation, perception, judgment, thought, emotion. We pass suddenly into another and wholly different world, where reigns an entirely different order of phenomena. The connection between these two orders of phenomena, the material and the mental, altho it is right here in the phenomena of the senses, and altho we bring to bear upon it the microscopic eye of science, is absolutely incomprehensible, and must in the very nature of things always remain so. Certain vibrations of the molecules of the brain, certain oxidations, with the formation of carbonic acid, water, and urea, are on the one side, and there appear on the other sensations, consciousness, thoughts, desires, volitions. There are, as it were, two sheets of blotting-paper pasted together: the one is the brain, the other is the mind. Certain ink-scratches and ink-blotchings, utterly meaningless on the one, soak through and appear on the other as intelligible writing. But how or why we know not, and can never hope even to guess. Certain physical phenomena—molecular vibrations, decompositions, and recompositions—occur, and there emerge, how we know not, psychical phenomena—thoughts, emotions, etc. Aladdin's lamp is rubbed—physical phenomenon—and the genie appears—psychical phenomenon.—LE COMTE *Sight*, ch. 3, p. 167. (A., 1897.)

3104. SIGNIFICATION OF LANGUAGE LEARNED BY DEAF-MUTE—*Dr. Howe and Laura Bridgman.*—Dr. Howe began to teach Laura Bridgman by gumming raised letters on various familiar articles. The child was taught by mere contiguity to pick out a certain number of particular articles when made to feel the letters. But this was merely a collection of particular signs, out of the mass of which the general purpose of signification had not yet been extracted by the child's mind. Dr. Howe compares his situation at this moment to that of one lowering a line to the bottom of the deep sea in which Laura's soul lay, and waiting until she should spontaneously take hold of it and be raised into the light. The moment came, "accompanied by a radi-

ant flash of intelligence and glow of joy"; she seemed suddenly to become aware of the general purpose embedded in the different details of all these signs, and from that moment her education went on with extreme rapidity.—JAMES *Psychology*, vol. ii, ch. 22, p. 358. (H. H. & Co., 1899.)

3105. SILENCE IN VACUUM—*Sound Demands a Medium.*—Sound cannot be transmitted through a vacuum, as shown by the following familiar experiment made by a philosopher named Hawksbee as far back as 1705. Place a bell that is operated by a clock-work inside of the receiver of an air-pump. This receiver is a large bell glass, ground to make an air-tight fit on the bed-plate of the air-pump. Suspend the bell inside the receiver, by some kind of cord that will not transmit sound, and then set it to ringing. At first it will ring as loudly as tho it were in the open air. Now, work the pump and exhaust the air. The sound will grow fainter until a nearly perfect vacuum is obtained, when the sound will cease, altho the hammer is still striking the bell the same as at first. Now let the air in and the ringing is heard again.—ELISHA GRAY *Nature's Miracles*, vol. ii, ch. 6, p. 62. (F. H. & H., 1900.)

3106. SILENCE PRODUCED BY INTERFERING SOUNDS—*Analogies of Sound and Light—Darkness Produced by Adding Light to Light.*—Thomas Young's fundamental discovery in optics was that the principle of interference was applicable to light. Long prior to his time an Italian philosopher, Grimaldi, had stated that under certain circumstances two thin beams of light, each of which, acting singly, produced a luminous spot upon a white wall, when caused to act together, partially quenched each other and darkened the spot. This was a statement of fundamental significance, but it required the discoveries and the genius of Young to give it meaning. How he did so will gradually become clear to you. You know that air is compressible; that by pressure it can be rendered more dense, and that by dilation it can be rendered more rare. Properly agitated, a tuning-fork now sounds in a manner audible to you all, and most of you know that the air through which the sound is passing is parceled out into spaces in which the air is condensed, followed by other spaces in which the air is rarefied. These condensations and rarefactions constitute what we call waves of sound. You can imagine the air of a room traversed by a series of such waves, and you can imagine a second series sent through the same air, and so related to the first that condensation coincides with condensation and rarefaction with rarefaction. The consequence of this coincidence would be a louder sound than that produced by either system of waves taken singly. But you can also imagine a state of things where the condensations of the one system fall upon the rarefactions of the other system. In this case the two systems would completely neutralize each other. Each of them taken singly produces sound; both of them taken together produce no sound. Thus, by adding sound to sound we produce silence, as Grimaldi in his experiment produced darkness by adding light to light.—TYNDALL *Lectures on Light*, lect. 2, p. 57. (A., 1898.)

3107. SIMILARITY, ASSOCIATION BY—*At the Foundation of Reasoning.*—After the few most powerful practical and esthetic interests, our chief help towards noticing those special characters of phenomena which, when once possessed and named, are used as reasons, class names, essences, or middle terms, is this association by similarity. Without it, indeed, the deliberate procedure of the scientific man would be impossible; he could never collect his analogous instances. But it operates of itself in highly gifted minds without any deliberation, spontaneously collecting analogous instances, uniting in a moment what in Nature the whole breadth of space and time keeps separate, and so permitting a perception of identical points in the midst of different circumstances, which minds governed wholly by the law of contiguity could never begin to attain.—JAMES *Psychology*, vol. ii, ch. 22, p. 347. (H. H. & Co., 1899.)

3108. SIMILARITY OF INVENTIONS—*How Far Denoting Unity of Race.*—It is agreed, then, by all that certain kinds of similarity may exist in regions wide apart independently when the occasion arises and the environment permits. It is also admitted that things may be so similar as to allow no doubt that they were created under the inspiration of the same teachers. There is, then, a criterion, a boundary line, not definitely fixed, perhaps, but a fence between those so-called similarities that arise independently and those which show acculturation of some kind. This fence must be largely psychological.

The question, I repeat, is not one of origins at all, but one of the number, kinds, and degrees of similarities in the artificialities of life. For example, the invention of the canoe is a natural, human process: the bark canoe is environmental, the birch-bark canoe is culture-historical. But what should we say of the Amur and the Columbia River types, each pointed beneath the water like a monitor and unlike any other species? Surely these must have some kind of acculturation. Now, if it be found that the Columbia stock and the Amur people have also the same name for their pointed canoes, and a multitude of other coordinated likenesses, then kinship of blood or nationality is proclaimed.—MASON *Similarities in Culture*, from the *American Anthropologist*, vol. viii, p. 115.

3109. SIMILARITY THE FOUNDATION OF SCIENCE, AS OF WIT—*Genius Involves Hard Work.*—The first discovery of

a new law is the discovery of a similarity which has hitherto been concealed in the course of natural processes. It is a manifestation of that which our forefathers in a serious sense described as "wit"; it is of the same quality as the highest performances of artistic perception in the discovery of new types of expression. It is something which cannot be forced, and which cannot be acquired by any known method. Hence all those aspire after it who wish to pass as the favored children of genius. It seems, too, so easy, so free from trouble, to get by sudden mental flashes an unattainable advantage over our contemporaries. The true artist and the true inquirer know that great works can only be produced by hard work.—HELMHOLTZ *Popular Lectures,* lect. 5, p. 227. (L. G. & Co., 1898.)

3110. SIMPLICITY OF METHOD—*Opens Way to Marvelous Result—Magnetism Converted into Electric Light—Faraday's Experiment.*—In the fall of 1831, Professor Faraday announced that from a magnet he had obtained electricity. On the 8th of February, 1832, he entered in his notebook: "This evening, at Woolwich, experimented with magnet, and for the first time got the magnetic spark myself. . . ."

Next day he repeated this experiment, and then, as was his habit, invited some of his friends to see the new light. He had a piece of soft iron, surrounded by coils of wire insulated with calico and tied by common string. When he touched the pole of a magnet with the soft iron, the ends of the coil, as he says, opened a little, and a spark passed between them. An electrical current had been caused in the coil.—PARK BENJAMIN *Age of Electricity,* ch. 7, p. 88. (S., 1897.)

3111. SIMPLICITY OF SCIENTIFIC DISCOVERY—*Forms of Leaves Modified by Environment.*—In the year 1851, during a country ramble in which the structures of plants had been a topic of conversation with a friend—Mr. G. H. Lewes—I happened to pick up the leaf of a buttercup, and, drawing it by its footstalk through my fingers so as to thrust together its deeply cleft divisions, observed that its palmate and almost radial form was changed into a bilateral one; and that were the divisions to grow together in this new position, an ordinary bilateral leaf would result. Joining this observation with the familiar fact that leaves, in common with the larger members of plants, habitually turn themselves to the light, it occurred to me that a natural change in the circumstances of the leaf might readily cause such a modification of form as that which I had produced artificially. If, as they often do with plants, soil and climate were greatly to change the habit of the buttercup, making it branched and shrublike, and if these palmate leaves were thus much overshadowed by one another, would not the inner segments of the leaves grow towards the periphery of the plant where the light was greatest, and so change the palmate form into a more decidedly bilateral form? Immediately I began to look round for evidence of the relation between the forms of leaves and the general characters of the plants they belong to, and soon found some signs of connection. Certain anomalies, or seeming anomalies, however, prevented me from then pursuing the inquiry much further. But consideration cleared up these difficulties; and the idea afterwards widened into the general doctrine [of morphological development] here elaborated.—SPENCER *Biology,* pt. iv, ch. 9, p. 160. (A., 1900.)

3112. ——— ——— *The Counting of Sun-spots Reveals Solar Period.*—Periodicity of the manifestation of solar activity is a fact now proved with the most unquestionable certainty. It was discovered by him who first thought of counting the spots on the sun. What a beautiful lesson for astronomical amateurs! How discoveries may be thus made by simple curiosity or by perseverance! What could apparently be more childish than the idea of amusing oneself by counting every day the spots on the sun? Nevertheless, the name of Schwabe will remain inscribed in the annals of astronomy for having thus discovered this mysterious period of eleven years in the variation of the solar spots.—FLAMMARION *Popular Astronomy,* bk. iii, ch. 5, p. 284. (A.)

3113. SINGING A PLEASURE TO SONG-BIRDS—*Brilliancy of Color Does Not Accompany Musical Power.*—The act of singing is evidently a pleasurable one; and it probably serves as an outlet for superabundant nervous energy and excitement, just as dancing, singing, and field sports do with us. It is suggestive of this view that the exercise of the vocal power seems to be complementary to the development of accessory plumes and ornaments, all our finest singing birds being plainly colored, and with no crests, neck or tail plumes to display, while the gorgeously ornamented birds of the tropics have no song, and those which expend much energy in display of plumage, as the turkey, peacock, birds of paradise, and humming-birds, have comparatively an insignificant development of voice.—WALLACE *Darwinism,* ch. 10, p. 192. (Hum.)

3114. SINGLENESS OF THEORY SOUGHT IN MEDICINE—*All Diseases To Be Referred to One Cause—"The Four Cardinal Fluids."*—What was not right was the [old] delusion that it was more scientific to refer all diseases to one kind of explanation than to several. What was called the "solidar pathology" wanted to deduce everything from the altered mechanism of the solid parts, especially from their altered tension; from the *strictum* and *laxum,* from tone and want of tone, and afterwards from

strained or relaxed nerves and from obstructions in the vessels. Humoral pathology was only acquainted with alterations in mixture. The four cardinal fluids, representatives of the classical four elements, blood, phlegm, black and yellow gall; with others, the acrimonies or dyscrasies, which had to be expelled by sweating and purging, . . . all these were elements of their chemistry.—HELMHOLTZ *Popular Lectures*, lect. 5, p. 210. (L. G. & Co., 1898.)

3115. SIZE RELATIVE—*Difference in Point of View—Microscopic Objects Regarded as Immense.*—To two men, one educated in the school of the senses, having mainly occupied himself with observation; the other educated in the school of imagination as well, and exercised in the conceptions of atoms and molecules to which we have so frequently referred, a bit of matter, say $\frac{1}{5000}$ of an inch in diameter, will present itself differently. The one descends to it from his molar heights, the other climbs to it from his molecular lowlands. To the one it appears small, to the other large. So, also, as regards the appreciation of the most minute forms of life revealed by the microscope. To one of the men these naturally appear conterminous with the ultimate particles of matter; there is but a step from the atom to the organism. The other discerns numberless organic gradations between both. Compared with his atoms, the smallest vibrios and bacteria of the microscopic field are as behemoth and leviathan.—TYNDALL *Fragments of Science*, vol. ii, ch. 8, p. 124. (A., 1897.)

3116. ——— ——— *Dimensions of Sun-spots—One Spot Might Engulf the Earth.*—The dimensions of sun-spots are sometimes enormous. Many groups have been observed covering areas of more than one hundred thousand miles square, and single spots have been known to measure forty or fifty thousand miles in diameter, the central umbra alone being twenty-five or thirty thousand miles across. A spot, however, measuring thirty thousand miles over all, would be considered large rather than small. —YOUNG *The Sun*, ch. 4, p. 126. (A., 1898.)

3117. SKELETON ADORNED WITH JEWELS—*Mother and Babe Perish Together—Remains at Pompeii.*—A very small number of skeletons have been discovered in either city [Herculaneum or Pompeii]; and it is clear that most of the inhabitants not only found time to escape, but also to carry with them the principal part of their valuable effects. In the barracks at Pompeii were the skeletons of two soldiers chained to the stocks, and in the vaults of a country house in the suburbs were the skeletons of seventeen persons, who appear to have fled there to escape from the shower of ashes. They were found enclosed in an indurated tuff, and in this matrix was preserved a perfect cast of a woman, perhaps the mistress of the house, with an infant in her arms. Altho her form was imprinted on the rock, nothing but the bones remained. To these a chain of gold was suspended, and on the fingers of the skeletons were rings with jewels. Against the sides of the same vault was ranged a long line of earthen amphoræ. —LYELL *Principles of Geology*, bk. ii, ch. 24, p. 391. (A., 1854.)

3118. SKEPTICISM, PSYCHOLOGICAL, CONTRADICTS ITSELF—*Duty and Morality Remain—Truth of Skeptical Denial Assumed.*—If you repeat again and again that there are only relative laws, no absolute truth and beauty and morality, that they are changing products of the outer conditions without binding power, you contradict yourself by the assertion. Do you not demand already for your skeptical denial that at least this denial itself is an absolute truth? And when you discuss it, and stand for your conviction that there is no morality, does not this involve your acknowledgment of the moral law to stand for one's conviction? . . . Psychological skepticism contradicts itself by its pretensions; there is a truth, a beauty, a morality, which is independent of psychological conditions.—MÜNSTERBERG *Psychology and Life*, p. 17. (H. M. & Co., 1899.)

3119. SKETCH OF CREATIVE PURPOSE IN EARLY FOSSILS—These early types seem to sketch in broad, general characters the creative purpose, and to include in the first average expression of the plan all its structural possibilities. The crinoid forms include the thought of the modern starfishes and sea-urchins; the simple chambered shells of the Silurian anticipate the more complicated structure of the later ones; the trilobites give the most comprehensive expression of the articulate type, while the early fishes not only prophesy the reptiles which are to come, but also hint at birds and even at mammalia by their embryonic development and their mode of reproduction. —AGASSIZ *Geological Sketches*, ser. i, ch. 2, p. 58. (H. M. & Co., 1896.)

3120. SKILL OF PRIMITIVE MAN IN STONE-WORKING—*Difficult for Civilized Man To Attain.*—Easy as it may seem to make such flakes as these [prehistoric flint specimens], a little practise will convince any one who attempts to do so, that a certain knack is required; and a gun-flint maker at Brandon told me that it took him two years to acquire the art. It is also necessary to be careful in selecting the flint. It is therefore evident that these flakes, simple as they may appear, are always the work of man. To make one, the flint must be held firmly, and then a considerable force must be applied, either by pressure or by blows repeated three or four times, but at least three, and given in certain slightly different directions, with a certain definite force; conditions which could scarcely occur

by accident; so that a flint flake, simple as it may seem to the untrained eye, is to the antiquary as sure a trace of man as the footprint in the sand was to Robinson Crusoe.—AVEBURY *Prehistoric Times*, ch. 4, p. 83. (A., 1900.)

3121. SKINS AS CLOTHING—*Woman the Skin Dresser of Ancient Times.*—If aught in the heavens above, or on the earth beneath, or in the waters wore a skin, savage women were found on examination to have had a name for it, and to have succeeded in turning it into its primitive use for human clothing, and to have invented new uses undreamed of by its original owner. . . . As any taxidermist, or farmer's boy, for that matter, knows, there are hosts of birds and fish and small mammals whose hides need only to be drawn off and dried wrong side out in the sun to be completely cured. The furrier has his way of keeping out the destructive insects, and the taxidermist knows the virtues of arsenical soap; but away on the boundaries of time or civilization the harmonies of Nature had not been so much disturbed, hence there was not such trouble with insect pests. Furthermore, the garment or what-not was in daily use until it was worn out, so there was poor chance for moths or dermestids.—MASON *Woman's Share in Primitive Culture*, ch. 4, p. 71. (A., 1894.)

3122. SKULL, PREHISTORIC, MIGHT HAVE BELONGED TO A PHILOSOPHER—*No Mark of Degradation in Engis Skull.*—Taking the evidence as it stands, and turning first to the Engis skull, I confess I can find no character in the remains of that cranium which, if it were a recent skull, would give any trustworthy clue as to the race to which it might appertain. Its contours and measurements agree very well with those of some Australian skulls which I have examined, and especially has it a tendency toward that occipital flattening, to the great extent of which in some Australian skulls I have alluded. But all Australian skulls do not present this flattening, and the superciliary ridge of the Engis skull is quite unlike that of the typical Australians. On the other hand, its measurements agree equally well with those of some European skulls. And assuredly there is no mark of degradation about any part of its structure. It is, in fact, a fair average human skull, which might have belonged to a philosopher or might have contained the thoughtless brains of a savage.—HUXLEY *Man's Place in Nature*, p. 253. (Hum.)

3123. SKY, ARTIFICIAL—*Composite Particles Too Small for Microscope—Infinitesimal Minuteness.*—Into an experimental tube I introduce a new vapor, . . . and add to it air which has been permitted to bubble through dilute hydrochloric acid. On permitting the electric beam to play upon the mixture, for some time nothing is seen. The chemical action is doubtless progressing, and condensation is going on; but the condensing molecules have not yet coalesced to particles sufficiently large to scatter sensibly the waves of light. . . . The particles here generated are at first so small that their diameters do not probably exceed a millionth of an inch; while to form each of these particles whole crowds of molecules are probably aggregated. Helped by such considerations, our intellectual vision plunges more profoundly into atomic Nature, and shows us, among other things, how far we are from the realization of Newton's hope that the molecules might one day be seen by means of microscopes. While I am speaking, you observe this delicate blue color forming and strengthening within the experimental tube. No sky-blue could exceed it in richness and purity; but the particles which produce this color lie wholly beyond our microscopic range. A uniform color is here developed, which has as little breach of continuity—which yields as little evidence of the individual particles concerned in its production—as that yielded by a body whose color is due to true molecular absorption. This blue is at first as deep and dark as the sky seen from the highest Alpine peaks, and for the same reason. But it grows gradually brighter, still maintaining its blueness, until at length a whitish tinge mingles with the pure azure, announcing that the particles are now no longer of that infinitesimal size which scatters only the shortest waves.—TYNDALL *Heat a Mode of Motion*, lect. 16, p. 490. (A., 1900.)

3124. SKY, CLOUDLESS, CONTAINS DUST-PARTICLES—*Matter from All Lands and from Celestial Spaces.*—Something, then, in a cloudless sky still exists to reflect the rays toward us, and this something is made up of separately invisible specks of dust and vapor, but very largely of actual dust, which probably forms the nucleus of each mist-particle. That discrete matter of some kind exists here has long been recognized from the phenomena of twilight; but it is, I think, only recently that we are coming to admit that a shell of actual solid particles in the form of dust probably encloses the whole globe, up to far above the highest clouds.

In 1881 the writer had occasion to conduct a scientific expedition to the highest point in the territories of the United States, on one of the summits of the Sierra Nevadas of Southern California, which rise even above the Rocky Mountains. . . . Yet even above here on the highest peak, where we felt as if standing on the roof of the continent and elevated into the great aerial currents of the globe, the telescope showed particles of dust in the air, which the geologists deemed to have probably formed part of the soil of China and to have been borne across the Pacific, but which also, as we

shall see later, may owe something to the mysterious source of the phenomena [meteors] already alluded to.—LANGLEY *The New Astronomy*, ch. 6, p. 179. (H. M. & Co., 1896.)

3125. SKY COMBINES ALL COLORS—*Blue Not Sole, but Predominant—Smallest Particles Reflect Smallest Waves.*—In the case of water, for example, a pebble will intercept and reflect a larger fractional part of a ripple than of a larger wave. We have now to imagine light-undulations of different dimensions, but all exceedingly minute, passing through air laden with extremely small particles. It is plain that such particles, tho scattering portions of all the waves, will exert their most conspicuous action upon the smallest ones; and that the color-sensation answering to the smallest waves—in other words, the color blue—will be predominant in the scattered light. This harmonizes perfectly with what we observe in the firmament. The sky is blue, but the blue is not pure. On looking at the sky through a spectroscope we observe all the colors of the spectrum; blue is merely the predominant color.—TYNDALL *Fragments of Science*, vol. i, ch. 5, p. 138. (A., 1897.)

3126. SLAVERY DEGRADES THE MASTERS—*Slave-making Ants Powerless to Help or Feed Themselves.*—*Polyergus rufescens* present a striking lesson of the degrading tendency of slavery, for these ants have become entirely dependent on their slaves. Even their bodily structure has undergone a change; the mandibles have lost their teeth, and have become mere nippers, deadly weapons, indeed, but useless except in war. They have lost the greater part of their instincts: their art, that is, the power of building; their domestic habits, for they show no care for their own young, all this being done by the slaves; their industry—they take no part in providing the daily supplies; if the colony changes the situation of its nest, the masters are all carried by the slaves on their backs to the new one; nay, they have even lost the habit of feeding. Huber placed thirty of them with some larvæ and pupæ and a supply of honey in a box. "At first," he says, "they appeared to pay some little attention to the larvæ; they carried them here and there, but presently replaced them. More than one-half of the Amazons died of hunger in less than two days. They had not even traced out a dwelling, and the few ants still in existence were languid and without strength. I commiserated their condition, and gave them one of their black companions. This individual, unassisted, established order, formed a chamber in the earth, gathered together the larvæ, extricated several young ants that were ready to quit the condition of pupæ, and preserved the life of the remaining Amazons."—AVEBURY *Ants, Bees, and Wasps*, ch. 4, p. 82. (A., 1900.)

3127. "SLEEP" OF PLANTS—*Purpose Not the Same as in Sleep of Animals.*—The so-called sleep of leaves is so conspicuous a phenomenon that it was observed as early as the time of Pliny; and since Linnæus published his famous essay, "Somnus Plantarum," it has been the subject of several memoirs. Many flowers close at night, and these are likewise said to sleep; but we are not here concerned with their movements, for altho effected by the same mechanism as in the case of young leaves, namely, unequal growth on the opposite sides (as first proved by Pfeffer), yet they differ essentially in being excited chiefly by changes of temperature instead of light, and in being effected, as far as we can judge, for a different purpose. Hardly any one supposes that there is any real analogy between the sleep of animals and that of plants, whether of leaves or flowers.—DARWIN *Power of Movement in Plants*, ch. 6, p. 283. (A., 1900.)

3128. SLEEP THE REPOSE OF THE BRAIN—*Rest of Voluntary and Involuntary Muscles Compared.*—All parts of the body which are the seat of active change require periods of rest. The alternation of work and rest is a necessary condition of their maintenance and of the healthy performance of their functions. These alternating periods, however, differ much in duration in different cases; but, for any individual instance, they preserve a general and rather close uniformity. Thus, as before mentioned, the periods of rest and work, in the case of the heart, occupy, each of them, about half a second; in the case of the ordinary respiratory muscles the periods are about four or five times as long. In many cases, again (as of the voluntary muscles during violent exercise), while the periods during active exertion alternate very frequently, yet the expenditure goes far ahead of the repair, and to compensate for this an after-repose of some hours becomes necessary, the rhythm being less perfect as to time than in the case of the muscles concerned in circulation and respiration.

Obviously, it would be impossible that in the case of the brain there should be short periods of activity and repose, or in other words, of consciousness and unconsciousness. The repose must occur at long intervals, and it must therefore be proportionately long. Hence the necessity for that condition which we call "sleep," a condition which, seeming at first sight exceptional, is only an unusually perfect example of what occurs, at varying intervals, in every actively working portion of our bodies.—BAKER *Handbook of Physiology*, vol. ii, ch. 18, p. 135. (W. W., 1885.)

3129. ——— ——— *Withdrawal of Blood Leaving Brain Anemic—Parallel of Swooning.*—A temporary abrogation of the functions of the cerebrum imitating sleep may occur, in the case of injury or disease,

as the consequence of two apparently widely different conditions. Insensibility is equally produced by a deficient and an excessive quantity of blood within the cranium (coma); but it was once supposed that the latter offered the truest analogy to the normal condition of the brain in sleep, and in the absence of any proof to the contrary the brain was said to be during sleep congested. Direct experimental inquiry has led, however, to the opposite conclusion.

By exposing, at a circumscribed spot, the surface of the brain of living animals, and protecting the exposed part by a watch-glass, Durham was able to prove that the brain becomes visibly paler (anemic) during sleep; and the anemia of the optic disk during sleep, observed by Hughlings Jackson, may be taken as a strong confirmation, by analogy, of the same fact.—BAKER *Handbook of Physiology*, vol. ii, ch. 18, p. 135. (W. W., 1885.)

3130. SLOWNESS OF ACTION OF TITANIC FORCES—*Gradual Growth of Continents—Earth Behaving Now Substantially as in Former Ages.*—When geologists began to unravel the earth's history, they were naturally led to suppose that the present was a time of unusual repose, the earlier ages having been periods when the forces which affect the earth were in a state of often recurring and violent activity. As long as the observer was compelled to conceive the construction of the world to have been accomplished in a few thousand years, it was inevitable that he should assume a certain violence in the development of the earth's features. Gradually the fancy for startling theories concerning the past history of this sphere which led to these views has, under the influence of better knowledge, been put aside. Geologists now believe that the continents have grown slowly from the seas, and that the mountains, with all their exhibitions of titanic energy, have likewise gradually come to their present state—in a word, that the crust of the earth behaves at the present day substantially as it has acted at all stages in its history, since life came upon it.—SHALER *Nature and Man in America*, ch. 4, p. 131. (S., 1899.)

3131. SMOKE AS A PRESERVATIVE OF FOOD AMONG SAVAGES—Smoke as a preservative of food is a very early invention. No sight is more common in a savage hut than that of a frame suspended over the fire in the center of the cabin for holding fish or meat to be dried out and smoked for future use. It will be readily seen that this was a potent factor in the increase of longevity, not only securing provisions for time of famine, but eliminating a portion of the noxious creatures that prey on subsistence and shorten life.—MASON *Origins of Invention*, ch. 3, p. 105. (S., 1899.)

3132. SNOW HOLDS WATER IN STORE—*Gradual Distribution in Place of Torrents and Floods.*—In mountainous regions it [snow] accumulates moisture that might otherwise have fallen in repeated torrents, tearing the soil from the mountainsides, inundating the valleys, and spending almost all its energy in destruction, and allows that moisture to be stored up for future use, to feed the streams that water the valleys, and to keep them filled with comparative regularity and constancy. In level countries it performs a similar service in another way, keeping the underlying ground refreshed with water that trickles from the snow as it is slowly melted from underneath by the warmth of the earth itself.—CHISHOLM *Nature-Studies*, p. 31. (Hum., 1888.)

3133. SNOW-CRYSTALS ON MOUNTAINTOPS—*Prisms Like Delicate Needles—Type Preserved through All Change.*—On the tops of mountains and in high latitudes, where the snow falls through the air at a very low temperature, the particles may take the form of extremely delicate needles, or may seem to resemble a fine white dust. But these needles, on a close examination, are found to be minute six-sided prisms, the sides of which are inclined to one another at precisely the same angle as would be formed by two lines joining the ends of three adjoining rays in an ordinary snowflake; and the particles of snow-dust may generally be found on examination with a lens to show at least the minute beginnings of rays such as are seen in more elaborate forms. Some of the beauty may be wanting, but the exquisite mathematical regularity is always there. It is this regularity which makes the form of a snowflake more wonderful, as we have said, than the form of the rain-drop. Wonderful it will always remain, even tho science should ultimately be able to explain the general laws under which particles of water assume this form in freezing.—CHISHOLM *Nature-Studies*, p. 26. (Hum., 1889.)

3134. SOAP-BUBBLE A UTENSIL OF SCIENCE—*Prismatic Colors Shown in Films.*—Any film whatever will produce these colors. The film of air between two plates of glass squeezed together exhibits, as shown by Hooke, rich fringes of color. . . . Nor is even air necessary; the rupture of optical continuity suffices. Smite with an ax the black, transparent ice—black because it is pure and of great depth—under the moraine of a glacier; you readily produce in the interior flaws which no air can reach, and from these flaws the colors of thin plates sometimes break like fire. But the source of most historic interest is, as already stated, the soap-bubble. With one of those mixtures employed by the eminent blind philosopher Plateau in his researches on the cohesion figures of thin films, we obtain in still air a bubble ten or twelve inches

in diameter. You may look at the bubble itself, or you may look at its projection upon the screen; rich colors arranged in zones are, in both cases, exhibited. Rendering the beam parallel, and permitting it to impinge upon the sides, bottom, and top of the bubble, gorgeous fans of color overspread the screen, rotating as the beam is carried round the circumference of the bubble. By this experiment the internal motions of the film are also strikingly displayed. [See COLORS OF THIN PLATES; FILMS; LIGHT.]—TYNDALL *Lectures on Light*, lect. 2, p. 67. (A., 1898.)

3135. SOCIABILITY A PROTECTION—*Gregarious Mammals Dominate the World—Cooperation and Sympathy Begin in the Lower Realm.*—Run over the names of the commoner or more dominant mammals, and it will be found that they are those which have at least a measure of sociability. The cat tribe excepted, nearly all live together in herds or troops—the elephant, for instance, the buffalo, deer, antelope, wild goat, sheep, wolf, jackal, reindeer, hippopotamus, zebra, hyena, and seal. These are mammals, observe—an association of sociability in its highest developments with reproductive specialization. Cases undoubtedly exist where the sociability may not be referable primarily to this function; but in most the chief cooperations are centered in love. So advantageous are all forms of mutual service that the question may be fairly asked whether after all cooperation and sympathy—at first instinctive, afterwards reasoned—are not the greatest facts even in organic Nature?—DRUMMOND *Ascent of Man*, ch. 7, p. 238. (J. P., 1900.)

3136. SOCIETY, MAN DEPENDENT ON—Man in himself is a defenseless, helpless creature. No other animal continues so long in a state of infancy, no other exists so long before obtaining its teeth, no other so long before it is able to stand, no other arrives so late at puberty. Even his greatest advantages, reason and speech, are but germs that develop not spontaneously, but only by means of external assistance, cultivation, and education. This necessity of assistance and his numerous urgent wants prove the natural destination of man for social connections.—BLUMENBACH *Manual of Natural History*, § 4, p. 35.

3137. SOIL PILED UP BY WORMS—*Materials Digested into Fertility.*—Worms have played a more important part in the history of the world than most persons would at first suppose. In almost all humid countries they are extraordinarily numerous, and for their size possess great muscular power. In many parts of England a weight of more than ten tons (10,516 kilograms) of dry earth annually passes through their bodies and is brought to the surface on each acre of land; so that the whole superficial bed of vegetable mold passes through their bodies in the course of every few years. From the collapsing of the old burrows the mold is in constant tho slow movement, and the particles composing it are thus rubbed together. By these means fresh surfaces are continually exposed to the action of the carbonic acid in the soil, and of the humus acids which appear to be still more efficient in the decomposition of rocks. The generation of the humus acids is probably hastened during the digestion of the many half-decayed leaves which worms consume. Thus the particles of earth, forming the superficial mold, are subjected to conditions eminently favorable for their decomposition and disintegration. Moreover, the particles of the softer rocks suffer some amount of mechanical trituration in the muscular gizzards of worms, in which small stones serve as mill-stones.—DARWIN *Formation of Vegetable Mould*, ch. 7, p. 89. (Hum., 1887.)

3138. SOILS, EXHAUSTION OF—*Rotation of Crops Scientific—Practise in Advance of Science.*—We know that a virgin soil cropped for several years loses its productive powers, and without artificial aid becomes unfertile. For example, through this exhaustion forty bushels of wheat per acre have dwindled to seven. Rotation of crops is an attempt to meet the problem, and the four-course rotation of turnips, barley, clover, and wheat witnesses to the fact that practise has been ahead of science in this matter.—NEWMAN *Bacteria*, ch. 5, p. 161. (G. P. P., 1899.)

3139. SOILS FERTILIZED BY BACTERIA—*Future Agriculturist Will Inoculate His Fields with the Most Useful Germs.*—Experiments which are now conducting seem to indicate that there are great differences in the vitality and nitrifying ability of different nitrobacteria. It is the present work of the chemist to compare the activity of the nitrifying organisms existing in the soils of widely separated localities and to isolate, if possible, those which show the highest qualities. When this shall have been accomplished, the novel practise will be seen of practical farmers inoculating their fields with minute capillary tubes containing a colorless liquid in almost an unweighably small quantity, in which are found invisible organisms by whose multiplication the fertilities of broad acres are to be increased. As the surgeon now prepares particles of virus which, when inserted into the system, produce immunity from contagious disease, so the farmer, by a similar species of inoculation, will render possible in his soil the growth of organisms which will increase the quantity and value of his crops.—WILEY *Relations of Chemistry to Industrial Progress (Address at Purdue University, Lafayette, Ind., May, 1896*, p. 38).

3140. ——— ——— *Nitrogen Essential to Fertility of Soils—Bacteria Seize Nitrogen of Air and Fix It in the Earth.*—A more important factor of soil fertility is its nitrogen content, without which it is completely barren. The origin of these nitrogen ingredients has been more or less of a puzzle. Fertile soil everywhere contains nitrates and other nitrogen compounds, and in certain parts of the world there are large accumulations of these compounds, like the nitrate beds of Chile. That they have come ultimately from the free atmospheric nitrogen seems certain, and various attempts have been made to explain a method of this nitrogen fixation. It has been suggested that electrical discharges in the air may form nitric acid, which would readily then unite with soil ingredients to form nitrates. There is little reason, however, for believing this to be a very important factor. But in the soil-bacteria we find undoubtedly an efficient agency in this nitrogen fixation. As already seen, the bacteria are able to seize the free atmospheric nitrogen, converting it into nitrites and nitrates. We have also learned that they can act in connection with legumes and some other plants, enabling them to fix atmospheric nitrogen and store it in their roots. By these two means the nitrogen ingredient in the soil is prevented from becoming exhausted by the processes of dissipation constantly going on. Further, by some such agency must we imagine the original nitrogen soil ingredient to have been derived. Such an organic agency is the only one yet discerned which appears to have been efficient in furnishing virgin soil with its nitrates, and we must therefore look upon bacteria as essential to the original fertility of the soil.—CONN *Story of Germ Life*, ch. 4, p. 115. (A., 1900.)

3141. SOLIDITY DECEPTIVE— *Earth's Surface a Thin Crust Covering a Molten Ocean.*—[We infer that the earth was once a molten mass] because the earth we tread is but a thin crust floating on a liquid sea of molten materials; because the agencies that were at work then are at work now, and the present is the logical sequence of the past. From Artesian wells, from mines, from geysers, from hot springs, a mass of facts has been collected, proving incontestably the heated condition of all substances at a certain depth below the earth's surface; and if we need more positive evidence, we have it in the fiery eruptions that even now bear fearful testimony to the molten ocean seething within the globe and forcing its way out from time to time. The modern progress of geology has led us by successive and perfectly connected steps back to a time when what is now only an occasional and rare phenomenon was the normal condition of our earth: when those internal fires were enclosed in an envelope so thin that it opposed but little resistance to their frequent outbreak, and they constantly forced themselves through this crust, pouring out melted materials that subsequently cooled and consolidated on its surface.—AGASSIZ *Geological Sketches*, ser. i, ch. 1, p. 3. (H. M. & Co., 1896.)

3142. SOLIDITY NOT REVEALED BY SIGHT—*The Visual Impression of Relief an Unconscious Derivation from Touch—Optical Illusion.*—That this idea of solidity is a matter of judgment was well shown by a photograph of a marble statue which I had an opportunity of seeing at a late exhibition. It was impossible not to believe that a marble statue was being looked at. The photograph was at the end of a room, and lighted on both sides, and not looked at through glass, nor the ordinary vision interfered with in any way. It will thus be seen that ideas of form gained by the sense of sight are essentially distinct from those derived by touch, and it is as impossible to explain to a congenitally blind man how form can be represented on a plane surface as it is to give him any ideas of color.—ELDRIDGE-GREEN *Memory and Its Cultivation*, pt. i, ch. 3, p. 11. (A., 1900.)

3143. SOLIDS CONQUERED BY YIELDING FLUIDS—*Air and Water Carve the Earth's Crust.*—We may take it that the denudation of the [earth's] surface, rendered everywhere so conspicuous by the discontinuity of strata, has been effected mainly by the atmosphere and running water.—GEIKIE *Earth Sculpture*, ch. 2, p. 40. (G. P. P., 1898.)

3144. SOLITUDE THE TERROR OF INFANCY—*A Protective Instinct.*—The great source of terror to infancy is solitude. The teleology of this is obvious, as is also that of the infant's expression of dismay—the never-failing cry—on waking up and finding himself alone.—JAMES *Psychology*, vol. ii, ch. 24, p. 418. (H. H. & Co., 1899.)

3145. SORROW RECALLS SORROW—*Memory Dominated by Mood—Joy Recalls Joy.*—The same objects do not recall the same associates when we are cheerful as when we are melancholy. Nothing, in fact, is more striking than our utter inability to keep up trains of joyous imagery when we are depressed in spirits. Storm, darkness, war, images of disease, poverty, and perishing afflict unremittingly the imaginations of melancholiacs. And those of sanguine temperament, when their spirits are high, find it impossible to give any permanence to evil forebodings or to gloomy thoughts. In an instant the train of association dances off to flowers and sunshine, and images of spring and hope.—JAMES *Psychology*, vol. i, ch. 14, p. 576. (H. H. & Co., 1899.)

3146. SOUL IN STONE—*First Explanation of Magnetic Power—The Magnet at the Foundation of Philosophy.*—Aristotle reports the sayings of Thales only by hearsay, and then with extreme caution: the

first being that everything is full of gods, and the second (and it is this which is of especial importance in our present research) that "Thales, too, as is related, seems to regard the soul as somehow producing motion, for he said that the stone has a soul, since it moves iron."

Thus we find the magnet at the very foundation of the world's philosophy. Refusing to account for the attraction of the lodestone by supernatural interposition, as the priests and worshipers at Samothrace had undoubtedly done centuries before, Thales assumed a soul or a virtue inherent and existing in the magnet itself, whereby it was enabled to move the iron.—PARK BENJAMIN *Intellectual Rise in Electricity*, ch. 2, p. 33. (J. W., 1898.)

3147. "SOUL OF LIFE," THE SUPPOSED VITAL FORCE—*Physician Thought To Deal with an Unseen Personality in Disease.*—The vital force had formerly lodged as ethereal spirit, as a pneuma in the arteries; it had . . . acquired its clearest scientific position as "soul of life." *anima inscia*, in Georg Ernst Stahl, who, in the first half of the last century, was professor of chemistry and pathology in Halle. . . . Stahl's "soul of life" is, on the whole, constructed on the pattern on which the pietistic communities of that period represented to themselves the sinful human soul: it is subject to errors and passions, to sloth, fear, impatience, sorrow, indiscretion, despair. The physician must first appease it, or then incite it, or punish it, and compel it to repent. And the way in which, at the same time, he established the necessity of the physical and vital actions was well thought out. The soul of life governs the body, and only acts by means of the physicochemical forces of the substances assimilated. But it has the power to bind and to loose these forces, to allow them full play or to restrain them. After death the restrained forces become free, and evoke putrefaction and decomposition. For the refutation of this hypothesis of binding and loosing, it was necessary to discover the law of the conservation of force.—HELMHOLTZ *Popular Lectures*, lect. 5, p. 215. (L. G. & Co., 1898.)

3148. SOUL, PSYCHOLOGY WITHOUT A—*Personality Explained by Ideas as a House by Stones and Bricks.*—Another . . . way of unifying the chaos [of mental impressions] is to seek common elements in the divers mental facts rather than a common agent behind them, and to explain them constructively by the various forms of arrangement of these elements, as one explains houses by stones and bricks. The "associationist" schools of Herbart in Germany, and of Hume, the Mills, and Bain in Britain, have thus constructed a psychology without a soul by taking discrete "ideas," faint or vivid, and showing how, by their cohesions, repulsions, and forms of succession, such things as reminiscences, perceptions, emotions, volitions, passions, theories, and all the other furnishings of an individual's mind may be engendered. The very self or *ego* of the individual comes in this way to be viewed no longer as the preexisting source of the representations, but rather as their last and most complicated fruit.—JAMES *Psychology*, vol. i, ch. 1, p. 1. (H. H. & Co., 1899.)

3149. SOUL, THE, A CAPACITY FOR GOD—*Shrinks and Shrivels without the Divine.*—The soul, in its highest sense, is a vast capacity for God. It is like a curious chamber added on to being and somehow involving being, a chamber with elastic and contractile walls which can be expanded with God as its guest, illimitably, but which without God shrinks and shrivels until every vestige of the Divine is gone, and God's image is left without God's Spirit. One cannot call what is left a soul; it is a shrunken, useless organ, a capacity sentenced to death by disuse, which droops as a withered hand by the side, and cumbers Nature like a rotted branch.—DRUMMOND *Natural Law in the Spiritual World*, essay 2, p. 98. (H. Al.)

3150. SOUL TRIUMPHS OVER BODY—*Insensibility to Pain under Strong Emotion — Soldier — Martyr — Devotee.*—Tho we speak of pleasure and pain as fixed and definite things, yet they are truly by no means fixed. It is matter of familiar experience that various circumstances may modify our sensibility in respect to things which are, in our ordinary state, painful. The power of mental excitement in this respect is well known. A soldier wounded during battle may feel no immediate suffering from the severest injury, and we have every-day proof of the same in the failure of slight accidents to pain us when we are intently occupied. All strong emotions, indeed, seem to have a similar power. It can scarcely be doubted that martyrs have sometimes gone through their flaming death in ecstasy. And the accounts we have of that fanatical sect in the East, one part of whose devotions consists in working themselves first into a frenzy, and then laying hold on glowing iron, dancing with it in their hands, and putting it to their lips, indicate not only an absence of pain in the act, but even some kind of pleasure. It would seem, indeed, that there is nothing that can be said to be always or necessarily a cause of pain. What we can truly say on this point is that there are certain things which are painful to our bodily senses when these are not controlled or modified by the state of the mind.—HINTON *The Mystery of Pain*, p. 20. (Hum., 1893.)

3151. SOUND CAUSES TERROR—*Subterranean Thunder Unexplained.*—Phenomena of sound, when unattended by any perceptible shocks, produce a peculiarly deep impression even on persons who have lived

in countries where the earth has been frequently exposed to shocks. A striking and unparalleled instance of uninterrupted subterranean noise, unaccompanied by any trace of an earthquake, is the phenomenon known in the Mexican elevated plateaux by the name of the "roaring and the subterranean thunder" *(bramidos y truenos subterraneos)* of Guanajuato. This celebrated and rich mountain city lies far removed from any active volcano. The noise began about midnight on the 9th of January, 1784, and continued for a month. I have been enabled to give a circumstantial description of it from the report of many witnesses, and from the documents of the municipality, of which I was allowed to make use. From the 13th to the 16th of January it seemed to the inhabitants as if heavy clouds lay beneath their feet, from which issued alternate slow rolling sounds and short, quick claps of thunder. The noise abated as gradually as it had begun. It was limited to a small space, and was not heard in a basaltic district at the distance of a few miles. Almost all the inhabitants, in terror, left the city, in which large masses of silver ingots were stored; but the most courageous, and those more accustomed to subterranean thunder, soon returned, in order to drive off the bands of robbers who had attempted to possess themselves of the treasures of the city. Neither on the surface of the earth, nor in mines 1,600 feet in depth, was the slightest shock to be perceived. No similar noise had ever before been heard on the elevated table-land of Mexico, nor has this terrific phenomenon since occurred there. —HUMBOLDT *Cosmos*, vol. i, p. 209. (H., 1897.)

3152. SOUND LAGGING AFTER SIGHT—*Ice-cliffs Seem to Fall in Silence—Slow Reverberations, as of Distant Battle.*—"The [Turner] glacier expands on entering the water, as is the habit of all glaciers of clear ice when unconfined, and ends in magnificent ice-cliffs some two miles in length. The water dashing against the bases of the cliffs dissolves them away, and the tide tends to raise and lower the expanded ice-foot. The result of these agencies and of the onward flow of the ice itself is to cause huge masses, sometimes reaching from summit to base of the cliffs, to topple over into the sea with a tremendous crash. Owing to the distance of the glacier from Haenke Island, we could see the ice fall long before the roar it caused reached our ears; the cliffs separated and huge masses seemed to sink into the sea without a sound; the spray thrown up as the blue pinnacles disappeared ascended like gleaming rockets, sometimes as high as the tops of the cliffs, and then fell back in silent cataracts of foam. Then a noise as of a cannonade came booming across the waters and echoing from cliff to cliff. The roar of the glacier continues all day when the air is warm and the sun is bright, and is most pronounced when the summer days are finest. Sometimes roar succeeds roar like artillery fire, and the salutes were answered, gun for gun, by the great Hubbard glacier, which pours its flood of ice into the fiord a few miles northeast of where Turner glacier terminates."—RUSSELL *Glaciers of North America*, ch. 6, p. 93. (G. & Co., 1897.)

3153. SOUND MAY QUENCH SOUND—*Interference of Sound-waves—Beats, What They Are.*—The most familiar illustration of the interference of sound-waves is furnished by the beats produced by two musical sounds slightly out of unison. When two tuning-forks in perfect unison are agitated together the two sounds flow without roughness, as if they were but one. But by attaching with wax to one of the forks a little weight, we cause it to vibrate more slowly than its neighbor. Suppose that one of them performs 101 vibrations in the time required by the other to perform 100, and suppose that at starting the condensations and rarefactions of both forks coincide. At the 101st vibration of the quickest fork they will again coincide, that fork at this point having gained one whole vibration, or one whole wave-length upon the other. But a little reflection will make it clear that, at the 50th vibration, the two forks are in opposition; here the one tends to produce a condensation where the other tends to produce a rarefaction; by the united action of the two forks, therefore, the sound is quenched, and we have a pause of silence. This occurs where one fork has gained half a wave-length upon the other. At the 101st vibration, as already stated, we have coincidence, and therefore augmented sound; at the 150th vibration we have again a quenching of the sound. Here the one fork is three half-waves in advance of the other. In general terms, the waves conspire when the one series is an even number of half-wave lengths, and they destroy each other when the one series is an odd number of half-wave lengths in advance of the other. With two forks so circumstanced, we obtain those intermittent shocks of sound, separated by pauses of silence, to which we give the name of beats. By a suitable arrangement, moreover, it is possible to make one sound wholly extinguish another. Along four distinct lines, for example, the vibrations of the two prongs of a tuning-fork completely blot each other out.—TYNDALL *Lectures on Light*, lect. 2, p. 61. (A., 1898.)

3154. SOUND, MINGLED WAVES OF—*Discriminating Power of the Ear.*—You must conceive the air of a concert-hall or ballroom as traversed in every direction, and not merely on the surface, by a variegated throng of intersecting wave-systems. From the mouths of the male singers proceed waves of six to twelve feet in length; from the lips of the songstresses dart shorter

waves, from eighteen to thirty-six inches long. The rustling of silken skirts excites little curls in the air, each instrument in the orchestra emits its peculiar waves, and all these systems expand spherically from their respective centers, dart through each other, are reflected from the walls of the room, and thus rush backwards and forwards until they succumb to the greater force of newly generated tones.

Altho this spectacle is veiled from the material eye, we have another bodily organ, the ear, especially adapted to reveal it to us. This analyzes the interdigitation of the waves, which in such a case would be far more confused than the intersection of the water undulations, and separates the several tones which compose it, and distinguishes the voices of men and women, nay, even of individuals, and of the peculiar qualities of tone given out by each instrument, the rustling of the dresses, the footfalls of the walkers, and so on.—HELMHOLTZ *On the Physiological Causes of Harmony in Music (Popular Lectures*, ser. i, p. 79). (Translated for *Scientific Side-Lights.)*

3155. SOURCE OF THE SUN'S HEAT —*By Combustion It Would Burn Out in Three Thousand Years.*—On earth the processes of combustion are the most abundant source of heat. Does the sun's heat originate in a process of this kind? To this question we can reply with a complete and decided negative, for we now know that the sun contains the terrestrial elements with which we are acquainted. Let us select from among them the two which, for the smallest mass, produce the greatest amount of heat when they combine; let us assume that the sun consists of hydrogen and oxygen, mixed in the proportion in which they would unite to form water. The mass of the sun is known, and also the quantity of heat produced by the union of known weights of oxygen and hydrogen. Calculation shows that under the above supposition the heat resulting from their combustion would be sufficient to keep up the radiation of heat from the sun for 3,021 years. That, it is true, is a long time, but even profane history teaches that the sun has lighted and warmed us for 3,000 years, and geology puts it beyond doubt that this period must be extended to millions of years. Known chemical forces are thus so completely inadequate, even on the most favorable assumption, to explain the production of heat which takes place in the sun, that we must quite drop this hypothesis.—HELMHOLTZ *Popular Lectures*, ser. ii, lect. 4, p. 178. (L. G. & Co., 1898.)

3156. SOURCE OF THE WINDS—*Circulation in Doorway of Heated Room—Currents of Aerial Ocean.*—From the heat of the sun our winds are all derived. We live at the bottom of an aerial ocean, in a remarkable degree permeable to the solar rays, and but little disturbed by their direct action. But those rays, when they fall upon the earth, heat its surface, and when they fall upon the ocean they provoke evaporation. The air in contact with the surface shares its heat, is expanded, and ascends into the upper regions of the atmosphere, while the vapor from the ocean also ascends, because of its lightness, carrying air along with it. Where the rays fall vertically on the earth, that is to say, between the tropics, the heating of the surface is greatest. Here aerial currents ascend and flow laterally, north and south, towards the poles, the heavier air of the polar regions streaming in to supply the place vacated by the light and warm air. Thus we have incessant circulation. A few days ago, in the hot room of a Turkish bath, I held a lighted taper in the open doorway, midway between top and bottom. The flame rose vertically from the taper. When placed at the bottom the flame was blown violently inwards; when placed at the top, it was blown violently outwards. Here we had two currents, or winds, sliding over each other, and moving in opposite directions. Thus, also, as regards our hemisphere, a current from the equator sets in towards the north and flows in the higher regions of the atmosphere, while, to supply its place, another flows towards the equator in the lower regions of the atmosphere. These are the upper and the lower trade winds.—TYNDALL *Heat a Mode of Motion*, lect. 8, p. 208. (A., 1900.)

3157. SPACE FILLED WITH LUMINIFEROUS ETHER—*No Empty Spot—Belief that Other Inhabited Worlds Exist.*—As far as our knowledge of space extends, we are to conceive it as the holder of the luminiferous ether, through which are interspersed, at enormous distances apart, the ponderous nuclei of the stars. Associated with the star that most concerns us we have a group of dark planetary masses revolving at various distances round it, each again rotating on its own axis; and, finally, associated with some of these planets we have dark bodies of minor note—the moons. Whether the other fixed stars have similar planetary companions or not is to us a matter of pure conjecture, which may or may not enter into our conception of the universe. But probably every thoughtful person believes, with regard to those distant suns, that there is in space something besides our system on which they shine.—TYNDALL *Fragments of Science*, vol. i, ch. 1, p. 5. (A., 1897.)

3158. SPACE IMPENETRABLE—*Giant Telescopes of Herschel and Rosse Leave Star Depths Yet Unfathomed.*—It has been said that with the telescopes with which the Herschels have surveyed the depths of heaven twenty millions of stars are visible. But these telescopes do not penetrate to the limits of the star system. In certain parts of the Milky Way Sir W. Herschel not only failed to penetrate the

star depths with his gaging telescope, tho the mirror was eighteen inches in width; but even when he brought into action his great forty-feet telescope, with its mirror four feet across, he still saw that cloudy light which speaks of star depths as yet unfathomed. Nay, the giant telescope of Lord Rosse has utterly failed to penetrate the ocean of space which surrounds us on all sides.—PROCTOR *Expanse of Heaven*, p. 302. (L. G. & Co., 1897.)

3159. SPACE, INFINITY OF—Space has no bounds. Whatever be the frontier which we may assign to it in thought, our imagination immediately flies across this frontier, and, looking beyond, still finds space. And altho we cannot comprehend the infinite, each of us feels that it is easier to conceive space as unlimited than to imagine it limited, and that it is impossible that space should not exist everywhere.—FLAMMARION *Popular Astronomy*, bk. vi, ch. 4, p. 590. (A.)

3160. ——— ——— There may exist round our visible universe an immense space, absolutely void and desert, beyond which, at immeasurable distances, lie other universes.—FLAMMARION *Popular Astronomy*, bk. vi, ch. 10, p. 670. (A.)

3161. SPACE, MATERIAL SUPPLIED TO EARTH FROM—*Ninety Thousand Tons of Meteoric Matter Annually Received.*—Day by day and year by year meteors are falling upon the earth, not by hundreds and thousands, but by thousands of millions. This process of growth is, however, exceedingly slow. Estimated, indeed, by the actual quantity of matter falling year by year upon the earth, it seems like a real, appreciable growth. For let us suppose that on the average each meteor of more than 140,000 millions which fall per annum weighs but a single grain. Then the earth's weight is increased each year by 20 millions of pounds, or by more than 90,000 tons. Yet this is a mere nothing compared with the actual weight of the earth. Supposing the matter thus received to be spread uniformly over the whole surface of the earth, it would form a layer less than the 800,000,000th part of an inch in thickness; so that at this rate 400 millions of years must elapse before the earth's diameter would be increased a single inch. Thus it may fairly be said that tho the earth is really acquiring new mass year by year, yet she is no longer growing appreciably in dimensions.—PROCTOR *Expanse of Heaven*, p. 178. (L. G. & Co., 1897.)

3162. SPECIALIZATION OF MOVEMENTS—*Functions Localized in Particular Regions of the Brain.*—Up to 1870 the opinion which prevailed was that which the experiments of Flourens on pigeons' brains had made plausible, namely, that the different functions of the hemispheres were not locally separated, but carried on each by the aid of the whole organ. Hitzig in 1870 showed, however, that in a dog's brain highly specialized movements could be produced by electric irritation of determinate regions of the cortex [of the brain]; and Ferrier and Munk, half a dozen years later, seemed to prove, either by irritations or excisions or both, that there were equally determinate regions connected with the senses of sight, touch, hearing, and smell.—JAMES *Psychology*, vol. i, ch. 2, p. 30. (H. H. & Co., 1899.)

3163. SPECIES, ABSOLUTENESS OF, A FALLACY—*The Doubts of Scientists.*—Much of the popular idea of the distinctness of all species rests on a fallacy, which is obvious enough when once pointed out. In systematic works every plant and animal must be referred to some species, every species is described by such and such marks, and in the books one species is as good as another. The absoluteness of species, being the postulate of the science, was taken for granted, to begin with; and so all the forms which have been named and admitted into the systematic works as species are thereby assumed to be completely distinct. All the doubts and uncertainties which may have embarrassed the naturalist when he proposed or admitted a particular species, the nice balancing of the probabilities and the hesitating character of the judgment, either do not appear at all in the record or are overlooked by all but the critical student.—ASA GRAY *Natural Science and Religion*, lect. 1, p. 39. (S., 1891.)

3164. SPECIES DEFINED—*Distinct Species of Bacteria Recognized.*—A word may be said here respecting the much-discussed question of species in bacteria. A species may be defined as "a group of individuals which, however many characters they share with other individuals, agree in presenting one or more characters of a peculiar and hereditary kind with some certain degree of distinctness." Now, as regards bacteria, there is no doubt that separate species occur and tend to remain as separate species. It is true, there are many variations, due in large measure to the medium in which the organisms are growing—variations of age, adaptation, nutrition, etc.—yet the different species tend to remain distinct. . . . But because of the occurrence of these morphological and even pathological differences it must not be argued that the demarcation of species is wholly arbitrary.—NEWMAN *Bacteria*, ch. 1, p. 29. (G. P. P., 1899.)

3165. SPECIES ONCE ABUNDANT NOW EXTINCT—*The Irish Elk.*—The magnificent Irish elk, or *Megaceros hibernicus*, which attained a height of more than ten feet, with antlers measuring eleven feet from tip to tip, may perhaps have lived to a somewhat more recent period, but appears to have had a much more restricted range [than the cave-bear, mammoth, etc.]. Its

remains have been found in Sweden, in Germany, in France as far as the Pyrenees, and in Central Italy. It seems, however, to have been most abundant in the British Isles, and especially in Ireland.—AVEBURY *Prehistoric Times*, ch. 9, p. 278. (A., 1900.)

3166. SPECIES, SUPPOSED, PROVED TO BE VARIETIES—A small butterfly *(Terias hecabe)* ranges over the whole of the Indian and Malayan regions to Australia, and everywhere exhibits great variations, many of which have been described as distinct species; but a gentleman in Australia bred two of these distinct forms *(T. hecabe* and *T. Æsiope)*, with several intermediates, from one batch of caterpillars found feeding together on the same plant. It is therefore very probable that a considerable number of supposed distinct species are only individual varieties.—WALLACE *Darwinism*, ch. 3, p. 31. (Hum.)

3167. SPECTACLE OF ACTION STIMULATES ACTION—*Value of Competition.*—The deepest spring of action in us is the sight of action in another. The spectacle of effort is what awakens and sustains our own effort. No runner running all alone on a race-track will find in his own will the power of stimulation which his rivalry with others incites, when he feels them at his heels, about to pass. When a trotting horse is "speeded," a running horse must go beside him to keep him to the pace.—JAMES *Talks to Teachers*, ch. 7, p. 53. (H. H. & Co., 1900.)

3168. SPECTROSCOPE HELPS SOLVE MYSTERY OF AURORA—*Determines What It Is Not—Its Light from Luminous Gases.*—If the light emanating from a solid or liquid incandescent body be passed through the spectroscope the resulting spectrum is continuous. If, on the contrary, the source of light is gaseous, the spectrum is composed of a certain number of bright lines or stripes, separated from each other by dark intervals. . . .

The spectrum of the aurora borealis, studied for the first time by Angstroem in 1866, is essentially a spectrum of lines; the light of the aurora is the product, therefore, of luminous gases, and not of solid or liquid incandescent particles; neither can it be due, as has sometimes been supposed, to a reflection of the light of the sun.—ANGOT *Aurora Borealis*, ch. 3, p. 42. (A., 1897.)

3169. SPECTRUM ANALYSIS—*Each Metal Gives Its Own Unvarying Bands—Distinction between Things Seemingly Identical.*—Within the camera is now placed a cylinder of carbon hollowed out at the top to receive a bit of metal; in the hollow is placed a fragment of the metal thallium. Down upon this we bring the upper carbon point, and then separate the one from the other. A stream of incandescent thallium vapor passes between them, the magnified image of which is now seen upon the screen. It is of a beautiful green color. What is the meaning of that green? We answer the question by subjecting the light to prismatic analysis. Sent through the prism, its spectrum is seen to consist of a single refracted band. Light of one degree of refrangibility, and that corresponding to this particular green, is emitted by the thallium vapor. We will now remove the thallium and put a bit of silver in its place. The arc of silver is not to be distinguished from that of thallium; it is not only green, but the same shade of green. Are they then alike? Prismatic analysis enables us to answer the question. However impossible it is to distinguish the one color from the other, it is equally impossible to confound the spectrum of incandescent silver vapor with that of thallium. In the case of silver, we have two green bands instead of one. . . . We have in these bands a perfectly unalterable characteristic of the two metals. You never get other bands than these two green ones from the silver, never other than the single green band from the thallium, never other than the three green bands from the mixture of both metals. Every known metal has its own particular bands, and in no known case are the bands of two different metals alike in refrangibility. It follows, therefore, that these spectra may be made a sure test for the presence or absence of any particular metal. If we pass from the metals to their alloys, we find no confusion. Copper gives green bands; zinc gives blue and red bands; brass, an alloy of copper and zinc, gives the bands of both metals, perfectly unaltered in position or character.—TYNDALL *Lectures on Light*, lect. 6, p. 193. (A., 1898.)

3170. ——— ——— *Gases Tell Their Story—Far-off Nebulæ Analyzed.*—If a solid or a liquid is heated to such an extent that it becomes incandescent, the spectrum which its light gives is, like the rainbow, a broad colored band without any breaks, with the well-known series of colors—red, yellow, green, blue, and violet, and in no wise characteristic of the nature of the body which emits the light.

The case is different if the light is emitted by an ignited gas or by an ignited vapor; that is, a substance vaporized by heat. The spectrum of such a body consists, then, of one or more, and sometimes even a great number, of entirely distinct bright lines, whose position and arrangement in the spectrum are characteristic for the substances of which the gas or vapor consists, so that it can be ascertained, by means of spectrum analysis, what is the chemical constitution of the ignited gaseous body. Gaseous spectra of this kind are shown in the heavenly space by many nebulæ: for the most part they are spectra which show the bright line of ignited hydrogen and oxygen, and along with it a line which, as yet, has never been again found in the spectrum

of any terrestrial element. Apart from the proof of two well-known terrestrial elements, this discovery was of the utmost importance, since it furnished the first unmistakable proof that the cosmical nebulæ are not, for the most part, small heaps of fine stars, but that the greater part of the light which they emit is really due to gaseous bodies.—HELMHOLTZ *Popular Lectures*, lect. 4, p. 152. (L. G. & Co., 1898.)

3171. SPECULATION CONFIRMED BY OBSERVATION—*Herschel's Explorations of the Heavens.*—The purely speculative conclusions arrived at by Wright, Kant, and Lambert, concerning the general structural arrangement of the universe, and of the distribution of matter in space, have been confirmed by Sir William Herschel, on the more certain path of observation and measurement. That great and enthusiastic, altho cautious, observer was the first to sound the depths of heaven in order to determine the limits and form of the starry stratum which we inhabit, and he, too, was the first who ventured to throw the light of investigation upon the relations existing between the position and distance of remote nebulæ and our own portion of the sidereal universe. William Herschel, as is well expressed in the elegant inscription on his monument at Upton, broke through the enclosures of heaven *(cœlorum perrupit claustra)*, and, like another Columbus, penetrated into an unknown ocean, from which he beheld coasts and groups of islands, whose true position it remains for future ages to determine.—HUMBOLDT *Cosmos*, vol. i, p. 87. (H., 1897.)

3172. SPECULATION, GEOLOGICAL—*Supposed Ancient Union of England and France.*—Whether England was formerly united with France has often been a favorite subject of speculation. So early as 1605 our countryman, Verstegan, in his "Antiquities of the English Nation," observed that many preceding writers had maintained this opinion, but without supporting it by any weighty reasons. He accordingly endeavors himself to confirm it by various arguments, the principal of which are, first, the proximity and identity of the composition of the opposite cliffs and shores of Albion and Gallia, which, whether flat and sandy or steep and chalky, correspond exactly with each other: secondly, the occurrence of a submarine ridge, called "our Lady's Sand," extending from shore to shore at no great depth, and which, from its composition, appears to be the original basis of the isthmus; thirdly, the identity of the noxious animals in France and England, which could neither have swum across, nor have been introduced by man. Thus no one, he says, would have imported wolves, therefore "these wicked beasts did of themselves pass over." He supposes the ancient isthmus to have been about six English miles in breadth, composed entirely of chalk and flint, and in some places of no great height above the sea-level. The operation of the waves and tides, he says, would have been more powerful when the straits were narrower, and even now they are destroying cliffs composed of similar materials. He suggests the possible cooperation of earthquakes; and when we consider how many submarine forests skirt the southern and eastern shores of England, and that there are raised beaches at many points above the sea-level, containing fossil shells of recent species, it seems reasonable to suppose that such upward and downward movements, taking place perhaps as slowly as those now in progress in Sweden and Greenland, may have greatly assisted the denuding force of "the ocean stream."—LYELL *Principles of Geology*, bk. ii, ch. 19, p. 315. (A., 1854.)

3173. SPECULATION, PRECARIOUSNESS OF—*Newton Timid There—Doubt, Conjecture, Question.*—Sir Isaac Newton never went beyond this field [of actual observation] without a reverential impression upon his mind of the precariousness of the ground on which he was standing. On this ground he never ventured a positive affirmation, but, resigning the lofty tone of demonstration, and putting on the modesty of conscious ignorance, he brought forward all he had to say in the humble form of a doubt, or a conjecture, or a question.—CHALMERS *Astronomical Discourses*, disc. 2, p. 52. (R. Ct., 1848.)

3174. SPEECH, LOSS OF POWER OF—*Motor Aphasia.*—Motor aphasia is neither loss of voice nor paralysis of the tongue or lips. The patient's voice is as strong as ever, and all the innervations of his hypoglossal and facial nerves, except those necessary for speaking, may go on perfectly well. He can laugh and cry, and even sing; but he either is unable to utter any words at all, or a few meaningless stock phrases form his only speech; or else he speaks incoherently and confusedly, mispronouncing, misplacing, and misusing his words in various degrees. Sometimes his speech is a mere broth of unintelligible syllables. In cases of pure motor aphasia the patient recognizes his mistakes and suffers acutely from them. Now whenever a patient dies in such a condition as this, and an examination of his brain is permitted, it is found that the lowest frontal gyrus is the seat of injury. Broca first noticed this fact in 1861, and since then the gyrus has gone by the name of Broca's convolution. The injury in right-handed people is found on the left hemisphere, and in left-handed people on the right hemisphere.—JAMES *Psychology*, vol. i, ch. 2, p. 37. (H. H. & Co., 1899.)

3175. SPEECH, ONOMATOPŒIC, LIMITATIONS OF—*Imitative Words Few—Language a System of Arbitrary Signs.*—When the Englishman and the Australian

speak each in his native tongue, only such words as belong to the interjectional and imitative classes will be naturally intelligible, and, as it were, instinctive to both. Thus the savage, uttering the sound "*waow!*" as an explanation of surprise and warning, might be answered by the white man with the not less evidently significant "*sh!*" of silence, and the two speakers would be on common ground when the native indicated by the name "*bwirri*," his cudgel, flung "*whirring*" through the air at a flock of birds, or when the native described as a "*jakkal-yakkal*" the bird called by the foreigner a "*cockatoo*." With these and other very limited classes of natural words, however, resemblance in vocabulary practically ceases. The Australian and English languages each consist mainly of a series of words having no apparent connection with the ideas they signify, and differing utterly.—DANIEL WILSON *Anthropology*, ch. 6, p. 23. (Hum., 1885.)

3176. SPEECH, PURPOSE UNDERLYING — *Man Demands a Word for Each Thing.*—When a dog yelps in front of a door, and his master, understanding his desire, opens it, the dog may, after a certain number of repetitions, get to repeat in cold blood a yelp which was at first the involuntary interjectional expression of strong emotion. The same dog may be taught to "beg" for food, and afterwards come to do so deliberately when hungry. . . . In each of these separate cases the particular sign may be consciously noticed by the animal, as distinct from the particular thing signified, and will thus, so far as it goes, be a true manifestation of language. But when we come to man we find a great difference. He has a deliberate intention to apply a sign to everything. The linguistic impulse is with him generalized and systematic. For things hitherto unnoticed or unfelt he desires a sign before he has one. Even tho the dog should possess his "yelp" for this thing, his "beg" for that, and his auditory image "rat" for a third thing, the matter with him rests there. If a fourth thing interests him for which no sign happens already to have been learned, he remains tranquilly without it, and goes no further. But the man postulates it, its absence irritates him, and he ends by inventing it. This general purpose constitutes, I take it, the peculiarity of human speech, and explains its prodigious development.—JAMES *Psychology*, vol. ii, ch. 22, p. 356. (H. H. & Co., 1899.)

3177. SPEED A SAFEGUARD—*The Humming-bird Secure with Brilliant Colors—Birds of Prey Pursue in Vain.*—In their [the humming-birds'] plumage, . . . Nature has strained at every variety of effect, and reveled in an infinitude of modifications. How wonderful their garb is, with colors so varied, so intense, yet seemingly so evanescent!—the glittering mantle of powdered gold; the emerald green that changes to velvet black; ruby reds and luminous scarlets; dull bronze that brightens and burns like polished brass, and pale, neutral tints that kindle to rose and lilac-colored flame. . . .

Excessive variation in this direction is checked in nearly all other birds by the need of a protective coloring, few kinds so greatly excelling in strength and activity as to be able to maintain their existence without it. Bright feathers constitute a double danger, for not only do they render their possessor conspicuous, but, just as the butterfly chooses the gayest flower, so do hawks deliberately single out from many obscure birds the one with brilliant plumage; but the rapacious kinds do not waste their energies in the vain pursuit of humming-birds. These are in the position of neutrals, free to range at will amidst the combatants, insulting all alike, and flaunting their splendid colors with impunity. They are Nature's favorites, endowed with faculties bordering on the miraculous, and all other kinds, gentle or fierce, ask only to be left alone by them.—HUDSON *Naturalist in La Plata*, ch. 16, p. 219. (C. & H., 1895.)

3178. SPEED, MEASURABLE, OF NERVE ACTION—*Volition Takes Time.*—By a series of very ingenious and conclusive experiments, the rate of passage of the nerve-force has been shown to be about ninety feet per second. This measure is made upon the course of the nerve-threads, and does not include the passage through the gray matter of the centers, with their mass of corpuscles. Now, the time of a complete circuit of action, beginning at a stimulation of the senses, and ending in certain movements, depends partly on the time of moving along the nerves, and partly on the time of passing through the centers, where a number of corpuscles must be traversed. Estimates have been made as to this last operation, which, from the nature of the case, is likely to be somewhat various; for not only may the central mass to be penetrated be of various extent, but also there is a liability to conflicting currents. The case of least internal delay is what is termed reflex action, where a motion answers to a stimulus without the intervention of the will, as in the involuntary start from a pinch in the hand. By experiments on frogs Helmholtz found that a period of from $\frac{1}{30}$ to $\frac{1}{10}$ of a second was occupied by the reflex act; now the length of the entire nerve-tract could only be a few inches, which would hardly occupy the two-hundredth of a second, if that tract were an uninterrupted nerve thread.—BAIN *Mind and Body*, ch. 3, p. 10. (Hum., 1880.)

3179. SPEED OF MENTAL ACTION—*Association Intensely Rapid—Naming of Separate Letters—Proof-reading.*—Reading exemplifies this kind of cohesion [by mental association]. It is an uninterrupted and pro-

tracted recall of sounds by sights which have always been coupled with them in the past. I find that I can name six hundred letters in two minutes on a printed page. Five distinct acts of association between sight and sound (not to speak of all the other processes concerned) must then have occurred in each second in my mind. In reading entire words the speed is much more rapid. Valentin relates in his "Physiology" that the reading of a single page of the proof, containing 2,629 letters, took him 1 minute and 32 seconds. In this experiment each letter was understood in $\frac{1}{28}$ of a second, but owing to the integration of letters into entire words, forming each a single aggregate impression directly associated with a single acoustic image, we need not suppose as many as 28 separate associations in a sound. The figures, however, suffice to show with what extreme rapidity an actual sensation recalls its customary associates. Both, in fact, seem to our ordinary attention to come into the mind at once.—JAMES *Psychology*, vol. i, ch. 14, p. 557. (H. H. & Co., 1899.)

3180. SPEED OF TORTOISE SCIENTIFICALLY MEASURED—The tortoises [of the Galapagos Islands], when purposely moving towards any point, travel by night and day, and arrive at their journey's end much sooner than would be expected. The inhabitants, from observing marked individuals, consider that they travel a distance of about eight miles in two or three days. One large tortoise, which I watched, walked at the rate of sixty yards in ten minutes—that is 360 yards in the hour, or four miles a day, allowing a little time for it to eat on the road.—DARWIN *Naturalist's Voyage around the World*, ch. 17, p. 383. (A., 1893.)

3181. SPEED OF TRAVEL ATTAINABLE BY MEANS OF BICYCLE—*Strength, Accuracy, and Lightness Combined.*—Almost as remarkable as our railroads and steamships is the new method of locomotion by means of the bicycle and tricycle. The principle is old enough, but the perfection to which these vehicles have now attained has been rendered possible by the continuous growth of all kinds of delicate tools and machines required in the construction of the infinitely varied forms of steam-engines, dynamos, and other rapidly moving machinery. In the last century it would not have been possible to construct a modern first-class bicycle, even if any genius had invented it, except at a cost of several hundred pounds. The combination of strength, accuracy, and lightness would not then have been attainable.—WALLACE *The Wonderful Century*, ch. 1, p. 9. (D. M. & Co., 1899.)

3182. SPIRITS, DISTILLED, A MEDIEVAL DISCOVERY—*Intemperance a Chief Evil of Modern World.*—It was not till the Middle Ages that distilled spirit, tho more ancient in the east, came into use among the western nations. It was generally accepted as beneficial, as is well seen in the name of "water of life," Latin, *aquavitæ;* French, *eau-de-vie;* Irish, *usquebaugh* (for shortness, *whisky*). Alcoholic spirit is now produced in immense quantities from the refuse of wine making, brewing, sugar-refining, etc. Its employment as a habitual stimulant is among the greatest evils of the modern world, bringing about in the low levels of the population a state of degradation hardly matched in the worst ages of history.—TYLOR *Anthropology*, ch. 11, p. 269. (A., 1899.)

3183. SPIRITUALITY THE GOAL OF EVOLUTION—*Victor Hugo: "The Tadpole of an Archangel."*—What strikes one most in running the eye up this graduated ascent [of life] is that the movement is in the direction of what one can only call spirituality. From the growl of a lion we have passed to the whisper of a soul, from the motive fear to the motive sympathy; from the icy, physical barriers of space to a nearness closer than breathing; from the torturing slowness of time to time's obliteration. If evolution reveals anything, if science itself proves anything, it is that man is a spiritual being, and that the direction of his long career is towards an ever larger, richer, and more exalted life. On the final problem of man's being the voice of science is supposed to be dumb. But this gradual perfecting of instruments—and, as each arrives, the further revelation of what lies behind in Nature—this gradual refining of the mind, this increasing triumph over matter, this deeper knowledge, this efflorescence of the soul, are facts which even science must reckon with. Perhaps, after all, Victor Hugo is right: "I am the tadpole of an archangel."—DRUMMOND *Ascent of Man*, ch. 5, p. 184. (J. P. & Co., 1900.)

3184. SPLENDOR THAT CONCEALS—*Night Has Revelations Even More Sublime than Day—From Star-clusters the Distant Universe Is Unseen.*—The blaze of light from the thousand thousand stars of their [dwellers on worlds in star-clusters] firmament must blot out all light from beyond. Their whole sky—by which I here mean the illuminated air which in the case of our own daylight limits our range of view, and forms a veil beyond which we cannot penetrate—their whole sky must be far more resplendent than ours, because every part has its hundreds on hundreds of suns. In this great splendor exists a perpetual limit to all extension of their researches into the constitution of the universe. The light of their myriads of suns blinds them to lights which lie beyond; their system of suns is their universe; and tho the universe thus revealed to them is magnificent and stupendous, yet we can see how minute it is, compared with what is revealed to ourselves,

when we remember that we can perceive many hundreds of such systems of suns.

Thus we learn how an excess of light may hide more than it reveals. . . . Night has its revelations, more wonderful in reality tho less splendid in seeming than the sun which rules the day.—PROCTOR *Expanse of Heaven*, p. 218. (L. G. & Co., 1897.)

3185. SPONTANEOUSNESS OF GROWTH—*Progress without Endeavor—Volition Simply Fulfils Conditions.*—There are three lines along which one may seek for evidence of the spontaneousness of growth. The first is science. And the argument here could not be summed up better than in the words of Jesus. The lilies grow, he says, of themselves; they toil not, neither do they spin. They grow—that is, automatically, spontaneously, without trying, without fretting, without thinking. Applied in any direction—to plant, to animal, to the body or to the soul—this law holds. A boy grows, for example, without trying. One or two simple conditions are fulfilled, and the growth goes on. He thinks, probably, as little about the condition as about the result; he fulfils the conditions by habit, the result follows by nature. Both processes go steadily on from year to year apart from himself, and all but in spite of himself. One would never think of telling a boy to grow. A doctor has no prescription for growth. He can tell me how growth may be stunted or impaired, but the process itself is recognized as beyond control—one of the few and therefore very significant things which Nature keeps in her own hands.—DRUMMOND *Natural Law in the Spiritual World*, essay 3, p. 113. (H. Al.)

3186. SPONTANEOUSNESS THE ATTRIBUTE OF HUMAN INTELLECT—*Mind of Man Included in Nature.*—We must understand it [Nature] as including every agency which we see entering, or can conceive from analogy as capable of entering, into the causation of the world. First and foremost among these is the agency of our own mind and will. Yet, strange to say, all reference to this agency is often tacitly excluded when we speak of the laws of Nature. One of our most distinguished living teachers of physical science, Professor Tyndall, began, not long ago, a course of lectures on the phenomena of heat, by a rapid statement of the modern doctrine of the correlation of forces —how the one was convertible into the other—how one arose out of the other—how none could be evolved except from some other as a preexisting source. "Thus," said the lecturer, "we see there is no such thing as spontaneousness in Nature." What!—not in the lecturer himself? Was there no "spontaneousness" in his choice of words —in his selection of materials—in his orderly arrangement of experiments with a view to the exhibition of particular results? It is not probable that the lecturer was intending to deny this; it simply was that he did not think of it as within his field of view. His own mind and will were then dealing with the "laws of Nature," but they did not occur to him as forming part of those laws, or, in the same sense, as subject to them.—ARGYLL *Reign of Law*, ch. 1, p. 4. (Burt.)

3187. SPOTS ON THE SUN—*Cooled Vapors Sinking Back on Central Mass—A Coolness Exceeding All Earthly Heat.*—Just on the edge of these [sun-]spots there are spectroscopic indications of the most violent motion, and in their vicinity there are often large protuberances; they show comparatively often a rotatory motion. They may be considered to be places where the cooler gases from the outer layers of the sun's atmosphere sink down, and perhaps produce local superficial coolings of the sun's mass. To understand the origin of these phenomena, it must be remembered that the gases, as they rise from the hot body of the sun, are charged with vapors of difficultly volatile metals, which expand as they ascend, and, partly by their expansion and partly by radiation into space, must become cooled. At the same time they deposit their more difficultly volatile constituents as fog or cloud. This cooling can only, of course, be regarded as comparative; their temperature is probably, even then, higher than any temperature attainable on the earth. If now the upper layers, freed from the heavier vapors, sink down, there will be a space over the sun's body which is free from cloud. They appear then as depressions, because about them are layers of ignited vapors as much as 500 miles in height.—HELMHOLTZ *Popular Lectures*, lect. 4, p. 160. (L. G. & Co., 1898.)

3188. ——— ——— *Solar Rotation Revealed.*—The study of solar physics may be said to have commenced with the discovery of the sun-spots, about 267 years ago. These spots were presently found to traverse the solar disk in such a way as to indicate that the sun turns upon an axis once in about twenty-six days. Nor will this rotation appear slow when we remember that it implies a motion of the equatorial parts of the sun's surface at a rate exceeding some seventy times the motion of our swiftest express trains.—PROCTOR *Other Worlds than Ours*, ch. 2, p. 35. (Burt.)

3189. SPREAD OF A PEST—*The Russian Thistle.*—About twenty years ago a colony of immigrants brought from the plains of southern Russia to the prairie region of Dakota a small quantity of flaxseed.

The flaxseed was sown in the fertile soil of the new home. It sprouted and grew. Along with it there also developed a slender, reddish plant, which seemed natural enough to the immigrants, for it had been common-

ly present in the crops on the far-away prairies from whence they came. . . .

This plant first appeared in a locality which was wooded and hilly, but in a few seasons it reached the adjacent plains, where it was rolled by the wind for miles and miles, each year afterward invading new territory. Within a dozen years it had spread throughout South Dakota, had entered North Dakota on the south, Iowa on the north, and Nebraska on the east. During the next few years it spread with marvelous rapidity, invading Minnesota, Wisconsin, Colorado, Illinois, and Ohio. Its progress was aided by the railroads that carried the seed to many distant localities, which quickly became new centers of distribution. Presumably, the plant [the Russian thistle or Russian cactus] will continue to spread by similar methods, and within a few years will be present in most of the United States.

In the plains region of southeastern Russia this plant has long been known as a noxious pest. On its account "the cultivation of crops has been abandoned over large areas in some of the provinces near the Caspian Sea." In our own West it has already caused damage amounting in a single State to millions of dollars a year.—WEED *Seed Travellers,* ch. 1, p. 21. (G. & Co., 1899.)

3190. SPREAD OF UNMOLESTED SPECIES—*Reindeer Naturalized in Iceland—Rapid Increase from Small Beginning—Man Aids Nature by Destroying Destroyers.*—As an example of the rapidity with which a large tract may become peopled by the offspring of a single pair of quadrupeds, it may be mentioned that in the year 1773 thirteen reindeer were exported from Norway, only three of which reached Iceland. These were turned loose into the mountains of Guldbringè Syssel, where they multiplied so greatly, in the course of forty years, that it was not uncommon to meet with herds, consisting of from forty to one hundred, in various districts.

The reindeer, observes a modern writer, is in Lapland a loser by his connection with man, but Iceland will be this creature's paradise. There is, in the interior, a tract which Sir G. Mackenzie computes at not less than forty thousand square miles, without a single human habitation, and almost entirely unknown to the natives themselves. There are no wolves; the Icelanders will keep out the bears, and the reindeer, being almost unmolested by man, will have no enemy whatever, unless it has brought with it its own tormenting gadfly.—LYELL *Principles of Geology,* bk. iii, ch. 41, p. 686. (A., 1854.)

3191. SPRINGS EXPLAINED BY ARTESIAN WELLS—*Lakes and Streams beneath the Earth.*—Much light has been thrown, of late years, on the theory of springs, by the boring of what are called by the French "Artesian wells," because the method has long been known and practised in Artois; and it is now demonstrated that there are sheets and in some places currents of fresh water at various depths in the earth. The instrument employed in excavating these wells is a large auger, and the cavity bored is usually from three to four inches in diameter. If a hard rock is met with it is first triturated by an iron rod, and the materials, being thus reduced to small fragments or powder, are readily extracted. To hinder the sides of the well from falling in, as also to prevent the spreading of the ascending water in the surrounding soil, a jointed pipe is introduced, formed of wood in Artois, but in other countries more commonly of metal. It frequently happens that after passing through hundreds of feet of retentive soils a water-bearing stratum is at length pierced, when the fluid immediately ascends to the surface and flows over. The first rush of the water up the tube is often violent, so that for a time the water plays like a fountain, and then, sinking, continues to flow over tranquilly, or sometimes remains stationary at a certain depth below the orifice of the well. This spouting of the water in the first instance is probably owing to the disengagement of air and carbonic acid gas, for both of these have been seen to bubble up with the water.—LYELL *Principles of Geology,* bk. ii, ch. 16, p. 233. (A., 1854.)

3192. SPUN GLASS FROM VOLCANO—*Pele's Hair—Artistic Birds' Nests—Man Imitates Nature's Product.*—Sometimes the passage of [volcanic] steam through a mass of molten glass produces large quantities of a material resembling spun glass. Small particles or shots of the glass are carried into the air and leave behind them thin, glassy filaments like a tail. At the volcano of Kilauea, in Hawaii, this filamentous volcanic glass is abundantly produced, and is known as "Pele's Hair"—Pele being the name of the goddess of the mountain. Birds' nests are sometimes found composed of this beautiful material. In recent years an artificial substance similar to this Pele's hair has been extensively manufactured by passing jets of steam through the molten slag of iron-furnaces; it resembles cotton-wool, but is made up of fine threads of glass, and is employed for the packing of boilers and other purposes.—JUDD *Volcanoes,* ch. 4, p. 71. (A., 1899.)

3193. SQUIRRELS PLANTING NUTS—*Animals as Seed Distributers.*—Even before the arrival of frosts many of these [nuts] are dropped by the aid of squirrels, gray and red, which cut the stems with their teeth. The leaves, with the help of the shifting winds, gently cover the fruit, or some portions of it, and make the best kind of protection from dry air and severe cold; and they come just in the nick of time. Dame

Nature is generous. She produces an abundance; enough to seed the earth and enough to feed the squirrels, birds, and some other animals. The squirrels eat many nuts, but I have seen them carry a portion for some distance in several directions, and plant one or two or three in a place, covering them well with soil. It may be the thought of the squirrel—I cannot read his thoughts—to return at some future time of need, as he often does. But in some cases he forgets the locality, or does not return because he has stored up more than he needs; or in some cases the squirrels leave that locality or are killed; in any such case the planted nuts are not disturbed. At all events, some of the nuts—one now and then is all that is needed—are allowed to remain where planted. In this way the squirrel is a benefit to the trees, and pays for the nuts he eats.—BEAL *Seed Dispersal*, ch. 7, p. 61. (G. & Co., 1898.)

3194. STABILITY OF NATURE ESSENTIAL TO PROSPERITY—*Earthquake Shocks Would Ruin England.*—Earthquakes alone are sufficient to destroy the prosperity of any country. If beneath England the now inert subterranean forces should exert those powers which most assuredly in former geological ages they have exerted, how completely would the entire condition of the country be changed! What would become of the lofty houses, thickly packed cities, great manufactories, the beautiful public and private edifices? If the new period of disturbance were first to commence by some great earthquake in the dead of the night, how terrific would be the carnage! England would at once be bankrupt; all papers, records, and accounts would from that moment be lost. Government being unable to collect the taxes, and failing to maintain its authority, the hand of violence and rapine would remain uncontrolled. In every large town famine would go forth, pestilence and death following in its train.—DARWIN *Naturalist's Voyage around the World*, ch. 14, p. 305. (A., 1898.)

3195. STABILITY OF THE ANCIENT MOUNTAINS—*The Evanescent Has Already Disappeared.*—Comparing mountain chain with mountain chain, we find, as might have been expected, that the oldest mountains, if they are the least prominent, are at the same time the most stable. They have endured so long that much of their primeval elevation has been lost; the weakly built structures have been demolished, and only the stronger now remain. Great rock-falls and landslips are therefore seldom heard of among such mountains. It is quite otherwise with the younger uplifts of the globe. The valleys of the Alps, the Caucasus, the Himalayas, the Cordilleras, and other chains of relatively recent age are cumbered with chaotic heaps of fallen rock-masses. From time to time peaks and whole mountain-sides collapse and slide into the valleys, and this rapid degradation will continue until every weak structure has been removed.—GEIKIE *Earth Sculpture*, ch. 5, p. 119. (G. P. P., 1898.)

3196. STAR, NEW, SUDDEN APPEARANCE OF—*The Burning of a Sun—Seen by Us Years after Its Occurrence.*—The appearance of "new stars" is not so very rare a phenomenon. Every one at all interested in such matters remembers that in 1866 a new star broke out in the Northern Crown so suddenly that it was shining as bright as the pole-star, where six hours before there had been nothing visible to the eye. Now, all stars are not as large as our sun, tho some are much larger; but there are circumstances which make it improbable that this was a small or near object, and it is well remembered how the spectroscope showed the presence of abnormal amounts of incandescent hydrogen, the material which is perhaps the most widely diffused in the universe (and which is plentiful, too, in our own bodies), so that there was some countenance to the popular notion that this was a world in flames. We were, at any rate, witnessing a catastrophe which no earthly experience can give us a notion of, in a field of action so remote that the flash of light which brought the news was unknown years on the way, so that all this—strange but now familiar thought—occurred long before we saw it happen. The star faded in a few days to invisibility to the naked eye, tho not to the telescope; and, in fact, all these phenomena at present appear rather to be enormous and sudden enlargements of the light of existing bodies than the creation of absolutely new ones; while of these "new stars" the examples may almost be said to be now growing numerous, two having appeared in the last two years.—LANGLEY *New Astronomy*, ch. 8, p. 230. (H. M. & Co., 1896.)

3197. ——— ——— *Wagoners Point Out Phenomenon to Astronomers—Wonder as in Ancient Days (Matt. ii, 2).*—The appearance of hitherto unseen stars in the vault of heaven, especially the sudden appearance of strongly scintillating stars of the first magnitude, is an occurrence in the realms of space which has ever excited astonishment. This astonishment is the greater, in proportion as such an event as the sudden manifestation of what was before invisible, but which nevertheless is supposed to have previously existed, is one of the very rarest phenomena in Nature. . . . It seems not inappropriate to quote the narrative of an eye-witness, and, by dwelling on a particular instance, to depict the vividness of the impression produced by the sight of a new star. "On my return to the Danish islands from my travels in Germany," says Tycho Brahe, "I resided for some time with my uncle, Steno Bille *(ut aulicæ vitæ fastidium lenirem)*, in the old and pleasantly situated monastery of Herritzwadt, and here

I made it a practise not to leave my chemical laboratory until the evening. Raising my eyes, as usual, during one of my walks, to the well-known vault of heaven, I observed, with indescribable astonishment, near the zenith, in Cassiopeia, a radiant fixed star, of a magnitude never before seen. In my amazement, I doubted the evidence of my senses. However, to convince myself that it was no illusion, and to have the testimony of others, I summoned my assistants from the laboratory and inquired of them, and of all the country people that passed by, if they also observed the star that had thus suddenly burst forth. I subsequently heard that in Germany wagoners and other common people first called the attention of astronomers to this great phenomenon in the heavens—a circumstance which, as in the case of non-predicted comets, furnished fresh occasion for the usual raillery at the expense of the learned."—HUMBOLDT *Cosmos*, vol. iii, p. 151. (H., 1897.)

3198. STAR-CLUSTERS—*Island Universes—Plurality of Worlds.*—The contemplation of the heavens affords no spectacle so grand and so eloquent as that of a cluster of stars. Most of them lie at such a distance that the most powerful telescopes still show them to us like star-dust. "Their distance from us is such that they are beyond, not only all our means of measurement," says Newcomb, "but beyond all our powers of estimation. Minute as they appear, there is nothing that we know of to prevent our supposing each of them to be the center of a group of planets as extensive as our own, and each planet to be as full of inhabitants as this one. We may thus think of them as little colonies on the outskirts of creation itself, and as we see all the suns which give them light condensed into one little speck, we might be led to think of the inhabitants of the various systems as holding intercourse with each other. Yet, were we transported to one of these distant clusters, and stationed on a planet circling one of the suns which compose it, instead of finding the neighboring suns in close proximity, we should see a firmament of stars around us, such as we see from the earth. Probably it would be a brighter firmament, in which so many stars would glow with more than the splendor of Sirius as to make the night far brighter than ours; but the inhabitants of the neighboring worlds would as completely elude telescopic vision as the inhabitants of Mars do here. Consequently, to the inhabitants of every planet in the cluster, the question of the plurality of worlds might be as insolvable as it is to us."—FLAMMARION *Popular Astronomy*, bk. vi, ch. 10, p. 660. (A.)

3199. ——— ——— *Minuteness of the Earth—The Vision of the Universe.*—There is still another very interesting tract of speculation, which has been opened up to us by the more recent observations of astronomy. What we allude to is the discovery of the nebulæ. We allow that it is but a dim and indistinct light which this discovery has thrown upon the structure of the universe; but still it has spread before the eye of the mind a field of very wide and lofty contemplation. Anterior to this discovery, the universe might appear to have been composed of an indefinite number of suns, about equidistant from each other, uniformly scattered over space, and each encompassed by such a planetary attendance as takes place in our own system. But we have now reason to think that instead of lying uniformly, and in a state of equidistance from each other, they are arranged into distinct clusters; that, in the same manner as the distance of the nearest fixed stars—so inconceivably superior to that of our planets from each other—marks the separation of the solar systems, so the distance of two contiguous clusters may be so inconceivably superior to the reciprocal distance of those fixed stars which belong to the same cluster as to mark an equally distinct separation of the clusters, and to constitute each of them an individual member of some higher and more extended arrangement. This carries us upwards through another ascending step in the scale of magnificence, and there leaves us in the uncertainty whether even here the wonderful progression is ended; and, at all events, fixes the assured conclusion in our minds that, to an eye which could spread itself over the whole, the mansion which accommodates our species might be so very small as to lie wrapped in microscopical concealment; and in reference to the only Being who possesses this universal eye, well might we say, "What is man, that thou art mindful of him; or the son of man, that thou shouldst deign to visit him?"—CHALMERS *Astronomical Discourses*, p. 35. (R. Ct., 1848.)

3200. STAR-COLORS DUE TO STELLAR ATMOSPHERES — *Celestial Signal-lamps.*—Hence we learn that the two stars [composing the double star Albireo or β Cygni] owe their color to the nature of their vaporous envelopes. Each star glows in reality with a white light; but the white light has in one case to pass through vapors of a somewhat ruddy hue (because absorbing blue light), and therefore this star looks ruddy, while the light of the other star shines through bluish vapors, and therefore this star looks blue. We do not yet know how it chances that the vaporous envelopes of these stars, and of other pairs of stars, differ in this way. Perhaps we shall never know. It is, however, an important gain to our knowledge to have ascertained that the colors of the double stars are not inherent, but that these stars are, as it were, celestial signal-lamps, shining through colored matter.—PROCTOR *Expanse of Heaven*, p. 225. (L. G. & Co., 1897.)

3201. STAR-COLORS REAL—*Spectrum Analysis of Double Stars.*—Spectrum analysis applied to the double stars has proved that the beautiful colors presented by these pairs are not due to the simple effect of contrast, but are real. The two suns which compose the double star β of Cygnus, one colored yellow and the other blue, show two spectra absolutely different. A similar observation, made on the two components of α Herculis, of which one is orange-colored and the other bluish green, has also shown spectra totally different. In each of these two cases the special color of each star agrees with the way in which the light is distributed in the different regions of its spectrum.—FLAMMARION *Popular Astronomy,* bk. vi, ch. 6, p. 612. (A.)

3202. STAR-DRIFTING—*Sets of Stars that Travel as Systems through Space—Ursa Major—Proctor's Prediction Verified.*—I have said that my object was to determine whether any set of stars show a tendency to drift together. . . . I predicted that whenever Dr. Huggins should apply to them [five specified stars of Ursa Major] the new spectroscopic method he would find that they were either all approaching or all receding, and at a common rate.

This prediction was exactly confirmed by the event two years later. It happened that Dr. Huggins had forgotten which of the seven stars form the drifting set of five. He proceeded, however, with his observations. He found both the remaining wheel-stars receding at the rate of about twenty miles per second. The star representing the first horse was found to be receding at the same rate, and lastly the star representing the second horse. Here, then, were five stars receding at the rate of about twenty miles per second; but Dr. Huggins supposed at the moment that these were not the five stars respecting which I had made my little prediction. On turning, however, to my "Other Worlds" (published two years before his observations were made), he found that it was the set of five stars which he had found to be thus receding at a common rate which I had described as, in my belief, forming a drifting set. I think the inference is fair that my general theory respecting local star-drifts is correct, and that among those stars which form our familiar systems there are groups traveling as systems through space.—PROCTOR *Expanse of Heaven,* p. 294. (L. G. & Co., 1897.)

3203. STARS AND NEBULÆ—*Nebulous Masses Intermixed with Stars.*—Some important points in cosmical economy have, indeed, become quite clear within the last thirty years, and scarcely any longer admit of a difference of opinion. One of these is that of the true status of nebulæ. This was virtually settled by Sir J. Herschel's description in 1847 of the structure of the Magellanic clouds; but it was not until Whewell in 1853, and Herbert Spencer in 1858, enforced the conclusions necessarily to be derived therefrom, that the conception of the nebulæ as remote galaxies, which Lord Rosse's resolution of many into stellar points had appeared to support, began to withdraw into the region of discarded and half-forgotten speculations. In the nubeculæ as Whewell insisted "there coexists in a limited compass and in indiscriminate position stars, clusters of stars, nebulæ regular and irregular, and nebulous streaks and patches. These, then, are different kinds of things in themselves, not merely different to us. There are such things as nebulæ side by side with stars and with clusters of stars. Nebulous matter resolvable occurs close to nebulous matter irresolvable."—CLERKE *History of Astronomy,* pt. ii, ch. 12, p. 505. (Bl., 1893.)

3204. STARS, A SEED-PLOT OF—*Our Sun a Star of the Milky Way.*—This seed-plot of stars [the Milky Way] is formed of objects individually invisible to the naked eye below the sixth magnitude, but so crowded that they appear to touch each other and form a nebulous gleam which all human eyes directed to the sky for thousands of years have contemplated and admired. Since it is developed like a girdle round the whole circuit of the sky, we ourselves must be in the Milky Way. The first fact which impresses our minds is that our sun is a star of the Milky Way.—FLAMMARION *Popular Astronomy,* bk. vi, ch. 10, p. 654. (A.)

3205. STARS, COUNTING OF—*Seven Thousand Visible to Naked Eye.*—According to this estimation, the number of stars of the first six magnitudes, or, in other words, the total number visible to the naked eye, is about 7,000. Excellent sight distinguishes 8,000, average sight about 5,700. Generally, we think we see many more; we believe we can count them by myriads, by millions; in this, as in other things, we are always led into exaggeration. As a matter of fact, however, the number of stars visible to the naked eye in both hemispheres all over the earth does not exceed the above figures. The stars visible to the naked eye for ordinary sight are in reality so few in number that we might easily show them in an illustration of the size of these pages, and count them: the southern hemisphere has 3,307, and the northern 2,478; total, 5,785, without counting, of course, the star-dust of the Milky Way. Thus we see with the naked eye fewer stars in the sky than there are inhabitants in a small town. It is, then, not so difficult to make their acquaintance as might be imagined. It is but an hour's amusement.—FLAMMARION *Popular Astronomy,* bk. vi, ch. 4, p. 586. (A.)

3206. STARS, DOUBLE, EFFECT OF—*Quadruple Alternation of Day and Night—Our Experience Not the Limit.*—Every one

of the worlds, in systems belonging to a double star, has a quadruple alternation, in place of that double alternation which we call day and night. There is, first, "double day," when both suns are above the horizon; next, single day with one sun; then single day with the other sun; and, lastly, true night, when both suns are below the horizon. —PROCTOR *Expanse of Heaven*, p. 228. (L. G. & Co., 1897.)

3207. STARS INNUMERABLE UNDER THE TELESCOPE—*Millions of Stars in the Milky Way.*—Let us point a telescope towards any point of this vaporous arch [the Milky Way]: suddenly hundreds, thousands of stars show themselves in the telescopic field like needle-points on the celestial vault. Let us wait for some moments, that our eye may become accustomed to the darkness of the background, and the little sparks shine out by thousands. Let us leave the instrument pointed motionless towards the same region, and there slowly passes before our dazzled vision the distant army of stars. In a quarter of an hour we see them appear by thousands and thousands. William Herschel counted 331,000 in a width of 5° in the constellation Cygnus, so nebulous to the naked eye. If we could see the whole of the Milky Way pass before us we should see 18 millions of stars.—FLAMMARION *Popular Astronomy*, bk. vi, ch. 10, p. 653. (A.)

3208. STARS LOST FROM THE HEAVENS—*Extinguished Suns.*—There are also cases where stars which had long been known to astronomers have disappeared altogether from view, so that their place knows them no more. It is possible that they may still give out some degree of light and heat, but the most powerful telescope fails to afford any sign of their existence, so that so far as our astronomers are concerned, these stars must be regarded as extinguished suns. It is at least certain that they have lost so large a proportion of the light and heat they once possessed that the change must seriously have affected the condition of beings living in the planets which doubtless circle around these once brilliant orbs.—PROCTOR *Expanse of Heaven*, p. 197. (L. G. & Co., 1897.)

3209. STARS NEWLY SEEN SUPPOSED NEWLY CREATED—*Wandering Nations Surprised by a New Heaven.*—In a fine episode to the Ramayana, the oldest heroic poem of Indian antiquity, the stars in the vicinity of the south pole are declared for a singular reason to have been more recently created than the northern. When Brahminical Indians were emigrating from the northwest to the countries around the Ganges, from the 30th degree of north latitude to the lands of the tropics, where they subjected the original inhabitants to their dominion, they saw unknown stars rising above the horizon as they advanced toward Ceylon. In accordance with ancient practise, they combined these stars into new constellations. A bold fiction represented the later-seen stars as having been subsequently created by the miraculous power of Visvamitra, who threatened the ancient gods that he would overcome the northern hemisphere with his more richly starred southern hemisphere" (A. W. von Schlegel, in the *Zeitschrift für die Kunde des Morgenlandes*, bd. i, s. 240). While this Indian myth figuratively depicts the astonishment excited in wandering nations by the aspect of a new heaven (as the celebrated Spanish poet, Garcilaso de la Vega, says of travelers, "they change at once their country and stars," *mudan de pays y de estrellas)*, we are powerfully reminded of the impression that must have been excited, even in the rudest nations, when, at a certain part of the earth's surface, they observed large, hitherto unseen stars appear in the horizon, as those in the feet of the Centaur, in the Southern Cross, in Eridanus or in Argo, while those with which they had been long familiar at home wholly disappeared.—HUMBOLDT *Cosmos*, vol. iii, p. 137. (H., 1897.)

3210. STARS OBSERVED BY DAY—*Companion Stars Discovered.*—The idea of observing the stars by daylight with a telescope first occurred to Morin, who, with Gascoigne (about 1638, before Picard and Auzout), combined instruments of measurement with the telescope. Morin himself says: "It was not Tycho's great observations in reference to the position of the fixed stars, when, in 1582, twenty-eight years before the invention of the telescope, he was led to compare Venus by day with the sun, and by night with the stars," but "the simple idea that Arcturus and other fixed stars might, like Venus, when once they had been fixed in the field of the telescope before sunrise, be followed through the heavens after the sun had risen, that led him to a discovery which might prove of importance for the determination of longitude at sea." No one was able before him to distinguish the fixed stars in the presence of the sun. Since the employment, by Römer, of great meridian telescopes in 1691, observations of the stars by day have been frequent and fruitful in results, having been, in some cases, advantageously applied to the measurement of the double stars. Struve states that he has determined the smallest distances of extremely faint stars in the Dorpat refractor, with a power of only 320, in so bright a crepuscular light that he could read with ease at midnight. The polar star has a companion of the ninth magnitude, which is situated at only 18″ distance; it was seen by day in the Dorpat refracting telescope by Struve and Wrangel, and was in like manner observed on one occasion by Encke and Argelander.—HUMBOLDT *Cosmos*, vol. iii, p. 66. (H., 1897.)

3211. STARS OF A NEW HEMISPHERE—*Sir John Herschel Opens the Study of the Southern Skies.*—"Strongly invited," as he [Sir John Herschel] tells us himself, "by the peculiar interest of the subject, and the wonderful nature of the objects which presented themselves," he resolved to attempt the completion of the survey in the southern hemisphere. With this noble object in view, he embarked his family and instruments on board the "Mount Stewart Elphinstone," and, after a prosperous voyage, landed at Cape Town on the 16th of January, 1834. Choosing as the scene of his observations a rural spot under the shelter of Table Mountain, he began regular "sweeping" on the 5th of March. The site of his great reflector is now marked with an obelisk, and the name of Feldhausen has become memorable in the history of science, for the four years' work done there may truly be said to open the chapter of our knowledge as regards the southern skies.—CLERKE *History of Astronomy*, pt. i, ch. 2, p. 56. (Bl., 1893.)

3212. STARS OF MANY COLORS—"*Star Differeth from Star in Glory*" *(1 Cor. xv, 41)—A Suggestion of the Foundations of the New Jerusalem (Rev. xxi, 19-21).*—In the heavens there are stars of many colors; for one star differeth from another in glory. But the colors we see with the unaided eye are far less beautiful and less striking than those which are brought into view by the telescope. And among the colored stars seen by the telescope there are none more beautiful than the colored pairs of stars. Amongst these we find the most strongly marked contrasts—such combinations as green and red, orange and blue, yellow and purple; then again we sometimes see both the companions of the same color; and yet again we find combinations where the contrast, tho not so striking as in the pairs first mentioned, is nevertheless exceedingly beautiful, as when we have gold and lilac, or white and blue, or white and green stars; and lastly, we find among the smaller companions of double stars such hues as gray, fawn, ash-colored, puce, mauve, russet, and olive.—PROCTOR *Expanse of Heaven*, p. 220. (L. G. & Co., 1897.)

3213. STARS OF THE ABYSS—*Phosphorescence of Echinoderms from Deep Sea—Starfish Coruscating with Green Light.*—Among the echinoderms we have not many recorded instances of a phosphorescent light being emitted, but it is quite possible that many, if not all of them, may possess this power. The curious deep-sea form, *Brisinga*, that was first discovered by Ch. Asbjörnsen, is known to be so brilliantly phosphorescent that it has been called a veritable *gloria maris*, and writing of the curious brittle-star *Ophiacantha spinulosa* (dredged by the "Porcupine" in 584 fathoms of water), Professor Wyville Thomson remarks that the light was of a "brilliant green, coruscating from the center of the disk, now along one arm, now along another, and sometimes vividly illuminating the whole outline of the starfish."—HICKSON *Fauna of the Deep Sea*, ch. 4, p. 81. (A., 1894.)

3214. STARS OF THE MILKY WAY—*Each Star a Sun—Myriad Centers of Light, Motion, and Power.*—The least of the stars seen in the galactic depths—even tho the telescope which reveals it be the mightiest yet made by man, so that with all other telescopes that star would be unseen—is a sun like our own. It is a mighty mass, capable of swaying by its attraction the motions of worlds, like our earth and her fellow planets, circling in their stately courses around it. It is an orb instinct with life (if one may so speak), aglow with fiery energy, pouring out each moment supplies of life and power to the worlds which circle around it. It is a mighty engine, working out the purpose of its great Creator; it is a giant heart, whose pulsations are the source whence a myriad forms of life derive support; and until the fuel which maintains its fires shall be consumed, that mighty engine will fulfil its work; until its life-blood shall be exhausted, that giant heart will throb unceasingly.—PROCTOR *Expanse of Heaven*, p. 300. (L. G. & Co., 1897.)

3215. STARS PRESENT NEW ASPECT TO MODERN WORLD—*Change Due to Precession of the Equinoxes.*—In consequence of the precession of the equinoxes the starry heavens are continually changing their aspect from every portion of the earth's surface. The early races of mankind beheld in the far north the glorious constellation of our southern hemisphere rise before them, which, after remaining long invisible, will again appear in those latitudes after the lapse of thousands of years. Canopus was fully 1° 20′ below the horizon at Toledo (39° 54′ north latitude) in the time of Columbus, and now the same star is almost as much above the horizon at Cadiz. While at Berlin and in the northern latitudes the stars of the Southern Cross, as well as α and β Centauri, are receding more and more from view, the Magellanic clouds are slowly approaching our latitudes. Canopus was at its greatest northern approximation during the last century, and is now moving nearer and nearer to the south, altho very slowly, owing to its vicinity to the south pole of the ecliptic.—HUMBOLDT *Cosmos*, vol. ii, pt. ii, p. 290. (H., 1897.)

3216. STARS, SPLENDOR OF, BUT PARTIALLY KNOWN TO MAN—*Our Atmosphere a Veil—Radiance in the Tropics—The Dimness of Distance.*—The splendor of these natural illuminations can hardly be conceived by our terrestrial imagination. The tints which we admire in these stars from here can give but a distant idea of the real value of their colors. Already, in pass-

ing from our foggy latitudes to the limpid regions of the tropics, the colors of the stars are accentuated, and the sky becomes a veritable casket of precious stones. What would it be if we could transport ourselves beyond the limits of our atmosphere? Seen from the moon these colors would be splendid. Antares, α Herculis, Pollux, Aldebaran, Betelgeuse, Mars, shine like rubies; the polar star, Capella, Castor, Arcturus, Procyon, are veritable celestial topazes; while Sirius, Vega, and Altair are diamonds eclipsing all by their dazzling whiteness. How would it be if we could approach the stars so as to perceive their luminous disks, instead of merely seeing brilliant points destitute of all diameter?—FLAMMARION *Popular Astronomy*, bk. vi, ch. 8, p. 637. (A.)

3217. STARS TEACH MAN'S WEAKNESS AND MAJESTY—*"What Is Man that Thou Art Mindful of Him? Thou Hast Made Him a Little Lower than the Angels" (Ps. viii, 4, 5).*—If the starry heavens, by incalculable numbers, magnitude, space, duration, and length of periods, impress man with the conviction of his own insignificance, his physical weakness, and the ephemeral nature of his existence, he is, on the other hand, cheered and invigorated by the consciousness of having been enabled, by the application and development of intellect, to investigate very many important points in reference to the laws of Nature and the sidereal arrangement of the universe.—HUMBOLDT *Cosmos*, vol. iii, p. 30. (H., 1897.)

3218. STARS THAT NEVER SET—*Circle of Perpetual Apparition.*—Now, to see the effect of the diurnal motion near the pole, let us watch any star in the north between the pole and the horizon. We shall soon see that, instead of moving from east to west, as we are accustomed to see the heavenly bodies move, it really moves towards the east. After passing the north point it begins to curve its course upwards, until, in the northeast, its motion is vertical. Then it turns gradually to the west, passing as far above the pole as it did below it, and, sinking down on the west of the pole, it again passes under it. The passage above the pole is called the upper culmination, and that below it the lower one. . . . We cannot with the naked eye follow it all the way round, on account of the intervention of daylight, but by continuing our watch every clear night for a year we should see it in every point of its course. A star following the course we have described never sets, but may be seen every clear night. If we imagine a circle drawn round the pole at such a distance as just to touch the horizon, all the stars situated within this circle will move in this way; this is therefore called the circle of perpetual apparition.—NEWCOMB *Popular Astronomy*, ch. 1, p. 11. (H., 1899.)

3219. STARS THAT SET SPEEDILY TO RISE AGAIN—*Newly Risen Comet Supposed To Be Another.*—As we go away from the pole we shall find the stars moving in larger circles, passing higher up over the pole, and lower down below it, until we reach the circle of perpetual apparition, when they will just graze the horizon. Outside this circle every star must dip below the horizon for a greater or less time, depending on its distance. If it be only a few degrees outside it will set in the northwest, or between north and northwest; and after a few hours only it will be seen to rise again between north and northeast, having done little more than graze the horizon. The possibility of a body rising so soon after having set does not always occur to those who live in moderate latitudes. In July, 1874, Coggia's comet set in the northwest about nine o'clock in the evening, and rose again about three o'clock in the morning; and some intelligent people who then saw it east of the pole supposed it could not be the same one that had set the evening before.—NEWCOMB *Popular Astronomy*, ch. 1, p. 11. (H., 1899.)

3220. STARS, TWINKLING OF, CAUSED BY OUR ATMOSPHERE—*Higher Mountains Give Purer Sky.*—Were the particles which produce the purer celestial vault all swept away, we should, unless helped by what has been called "cosmic dust," look into the blackness of celestial space. And were the whole atmosphere abolished along with its suspended matter we should have the "blackness" spangled with steady stars; for the twinkling of the stars is caused by our atmosphere. Now, the higher we ascend, the more do we leave behind us the particles which scatter the light; the nearer, in fact, do we approach to that vision of celestial space . . . Viewed, therefore, from the loftiest Alpine summits, the firmamental blue is darker than it is ever observed to be from the plains.—TYNDALL *Fragments of Science*, vol. i, ch. 5, p. 139. (A., 1897.)

3221. ——— ——— *Partly Inherent, Partly Atmospheric—The White Stars Scintillate Most, the Orange or Red Least—"Star Differeth from Star in Glory" (1 Cor. xv, 41).*—Who has not been struck with the scintillation of the stars? While the planets, even the brightest, radiate a calm and motionless light, the stars, even the least brilliant, appear more or less agitated by a wavering and variable light. This light, which glimmers sometimes vividly, sometimes feebly, in intermittent gleams, sometimes white, green, or red, like the flashing fires of a limpid diamond, seems to animate the interstellar solitudes, and makes us think of eyes opened in the heavens. It is like a calm and transparent sea on which flit lamps lighted by other mortals: the silence is as profound, but the desert is less void, and it seems that we

divine better the distant life which is in motion round each of these brilliant fires burning in infinitude. . . .

Scintillation is a phenomenon caused partly by the intrinsic light and partly by the state of our atmosphere. .

The stars which scintillate most are the white stars, like Sirius, Vega, . . . etc. [86 variations per second]. The stars which scintillate least are the orange or red stars, like Antares, Aldebaran, Arcturus, . . . etc. [56 variations per second]. There is thus a certain correspondence between the scintillation of a star and its physical constitution. . . .

Our atmosphere plays a considerable part in the scintillation; the lower a star is, the more it scintillates; the scintillation is proportional to the product which we obtain by multiplying the thickness of the layer of air traversed by the luminous ray emanating from the star by the astronomical refraction for the altitude at which it is observed.

The scintillation is more pronounced as the cold is greater; it is stronger in winter than in summer—a fact which may be noticed by everybody.—FLAMMARION *Popular Astronomy*, bk. vi, ch. 6, p. 606. (A.)

3222. STARS WITHDRAWN FROM NORTHERN SKIES—*Change in the Heavens.*—It was not more than 2,900 years before our era that the Cross (the Southern Cross) became invisible in northern Germany. The constellation had ascended as far as the tenth degree above the horizon. When it disappeared from the Baltic skies, the pyramid of Cheops had already stood five hundred years. The shepherd nation of the Hyksos invaded Egypt seven hundred years later. The past becomes apparently less remote when we can measure it by reference to memorable events.—HUMBOLDT *Cosmos*, vol. ii, pt. ii, p. 290. (H., 1897.)

3223. STARS WITHOUT LIGHT—*Non-luminous Bodies May Have Brilliant Satellites.*—The belief in the existence of non-luminous stars was diffused even among the ancient Greeks, and especially in the earliest ages of Christianity. It was assumed that among the fiery stars which are nourished by the celestial vapors there revolve certain other earthlike bodies, which, however, remain invisible to us. The total extinction of new stars, especially of those so carefully observed by Tycho Brahe and Kepler in Cassiopeia and Ophiuchus, appears to corroborate this opinion. Since it was at the time conjectured that the first of these stars had already twice appeared, and that, too, at intervals of nearly 300 years, the idea of annihilation and total extinction naturally gained little or no credit. The immortal author of the "Mécanique Céleste" [Laplace] bases his conviction of the existence of non-luminous masses in the universe on these same phenomena of 1572 and 1604: "These stars, that have become invisible after having surpassed the brilliancy of Jupiter, have not changed their place during the time of their being visible." (The luminous process in them has simply ceased.) "There exist, therefore, in celestial space dark bodies of equal magnitudes, and probably in as great numbers as the stars." So also Mädler, in his "Untersuchungen über die Fixstern-Systeme," says: "A dark body might be a central body; it might, like our own sun, be surrounded in its immediate neighborhood only by dark bodies like our planets. The motions of Sirius and Procyon, pointed out by Bessel, force us to the assumption that there are cases where luminous bodies form the satellites of dark masses."—HUMBOLDT *Cosmos*, vol. iii, p. 187. (H., 1897.)

3224. STATES, MENTAL, RESULT IN PHYSICAL ACTION—*Interdependence of Body and Mind.*—The psychologist is forced to be something of a nerve-physiologist. Mental phenomena are not only conditioned *a parte ante* by bodily processes; but they lead to them *a parte post.* That they lead to acts is of course the most familiar of truths, but I do not merely mean acts in the sense of voluntary and deliberate muscular performances. Mental states occasion also changes in the caliber of blood-vessels, or alteration in the heart-beats, or processes more subtle still, in glands and viscera. If these are taken into account, as well as acts which follow at some remote period because the mental state was once there, it will be safe to lay down the general law that no mental modification ever occurs which is not accompanied or followed by a bodily change. The ideas and feelings, *e. g.* which these present printed characters excite in the reader's mind not only occasion movements of his eyes and nascent movements of articulation in him, but will some day make him speak, or take sides in a discussion, or give advice, or choose a book to read, differently from what would have been the case had they never impressed his retina.—JAMES *Psychology*, vol. i, ch. 1, p. 5. (H. H. & Co., 1899.)

3225. STEAM-JETS IN NATURE—*Volcanoes the Vents for Imprisoned Waters.*—If water be subjected to sufficiently great pressure it may be raised to a very high temperature and still retain its liquid condition. When this pressure is removed, however, the whole mass passes at once into the condition of steam or water-gas, and the gas thus formed at high temperatures has a proportionably high tension. In a Papin's digester water confined in a strong vessel is raised to temperatures far above its ordinary boiling-point, and from any opening in such a vessel the steam escapes with prodigious violence. Now, at considerable depths beneath the earth's surface, and under the pressure of many hundreds or thousands of feet of solid rock, water still retaining its liquid condition may be-

come intensely heated. When the pressure is relieved by the formation of a crack or fissure in the superincumbent mass of rock, the escape of the superheated steam will be of very violent character, and may be attended with the most striking and destructive results. In the existence of high temperatures beneath the earth's surface, and the presence in the same regions of imprisoned water capable of passing into the highly elastic gas which we call steam, we have a cause fully competent to produce all the phenomena which we have described as occurring at Stromboli.—JUDD *Volcanoes*, ch. 2, p. 21. (A., 1899.)

3226. STEAM-NAVIGATION—*Its Gradual Development.*—From the earliest dawn of history men used rowing or sailing vessels for coasting trade or for crossing narrow seas. The Carthaginians sailed nearly to the equator on the west coast of Africa, and in the eleventh century the Northmen reached North America on the coast of New England. Exactly five hundred years ago Vasco da Gama sailed from Portugal round the Cape of Good Hope to India, and in the next century Columbus and his Spanish followers crossed the Atlantic in its widest part to the West Indies and Mexico. From that time sailing ships were gradually improved, till they culminated in our magnificent frigates for war purposes and the clipper ships in the China and Australian trade, which were in use up to the middle of the century. But during all this long course of development there was no change whatever in principle, and the grandest three-decker or full-rigged clipper ship was but a direct growth, by means of an infinity of small modifications and improvements, from the rudest sailing boat of the primeval savage. Then, at the very commencement of the present [nineteenth] century, the totally new principle of steam-propulsion began to be used, at first experimentally and with many failures, on rivers, canals, and lakes, till about the year 1815 coasting steamships of small size came into pretty general use. These were rapidly improved; but it was not till the year 1838 that the "Great Western," of 1,340 tons and 400 horse-power, made the passage from Bristol to New York in fourteen days, and thus inaugurated the system of ocean steam-navigation which has since developed to such an enormous extent.—WALLACE *The Wonderful Century*, ch. 1, p. 8. D. M. & Co., 1899.)

3227. STEEL AS A FACTOR IN HUMAN PROGRESS—*Iron the Universal Metal—Metallurgy Dependent on Chemistry.*—Without metal-working, civilization, as we understand it at the present day, would be impossible. Much has been made possible in the past half-century by progress in the metallurgy of iron alone. It seems almost incredible, but it is nevertheless a fact, that steel has been sold in the United States in the last few years at a price per ton which is often obtained for hay. Iron is the universal metal. It is found in every human trade, and devoted to every possible technical art. Steel, which is only a peculiar variety of iron, can be made almost as cheap as pig iron itself. Dominant in the arts of peace, as it is in the art of war, it rules every battle, whether of peace or war. It is doubtful whether any missionary effort, no matter how successful it has been, has had an influence on the development of humanity such as has been exercised by the Bessemer converter. Iron and steel are almost synonyms for progress and intelligence. It is not necessary to spend any time to show how intimately the science and art of chemistry are interwoven with the metallurgy of iron and steel. Every step has been made possible by the researches of the chemist, and every improvement in the application of chemical principles.—WILEY *Relations of Chemistry to Industrial Progress (Address at Purdue University, Lafayette, Ind., 1896*, p. 22).

3228. STELLAR PERPLEXITIES—*Nebulæ, Star-clusters, or Stars in Perspective?*—A region which appears singularly rich in stars may be a true star-cluster—a subordinate star-system—or it may be a region where the line of sight passes through an almost interminable range of stars. Seemingly minute stars may form schemes of suns far smaller than our own, or than any of the leading orbs of the heavens, or they may be orbs surpassing even Sirius in magnitude and splendor, but set at depths compared with which his enormous distance is relatively as insignificant as the distance of our moon compared with the dimensions of the solar system. A cloud of light in the star-depths may be a vast mass of nebulous matter, or it may be a scheme of stars as magnificent as the most splendid of all the star-clusters discernible with the telescope.—PROCTOR *Our Place among Infinities*, p. 207. (L. G. & Co., 1897.)

3229. STILLNESS OF THE DEEP SEA—*Animals There Found Less Muscular in Consequence.*—It is very probable, however, that these currents at the bottom of the ocean are extremely slow, and as the water is never affected by tides or storms, the general character of the deep sea is probably one of calm repose. This is a matter of no little importance; for, in the consideration of the characters presented by the fauna of any particular region, it is always necessary to take into account the physical difficulties the animals have to contend against and the modifications of structure they present to combat these difficulties. Thus in a region such as that presented by the deep sea, where there are no rapid tides, we should not expect to find such a powerful set of body muscles in the free-swimming forms, nor such a firm vertebral column as in the

animals that live in more lively water.—HICKSON *Fauna of the Deep Sea*, ch. 2, p. 34. (A., 1894.)

3230. ——— ——— *Strata Deposited by Currents.*—It appears extraordinary that in some tracts of the sea adjoining the coast of England, where we know that currents are not only sweeping along rocky masses, thrown down from time to time from the high cliffs, but also occasionally scooping out channels in the regular strata, there should exist fragile shells and tender zoophytes in abundance, which live uninjured by these violent movements. The ocean, however, is in this respect a counterpart of the land; and as, on the continents, rivers may undermine their banks, uproot trees, and roll along sand and gravel, while their waters are inhabited by testaceans and fish, and their alluvial plains are adorned with rich vegetation and forests, so the sea may be traversed by rapid currents, and its bed may here and there suffer great local derangement, without any interruption of the general order and tranquillity. It has been ascertained by soundings in all parts of the world that where new deposits are taking place in the sea coarse sand and small pebbles commonly occur near the shore, while farther from land and in deeper water finer sand and broken shells are spread out over the bottom. Still farther out the finest mud and ooze are alone met with. Mr. Austen observes that this rule holds good in every part of the English Channel examined by him. He also informs us that where the tidal current runs rapidly in what are called "races," where surface undulations are perceived in the calmest weather, over deep banks, the discoloration of the water does not arise from the power of such a current to disturb the bottom at a depth of 40 or 80 fathoms, as some have supposed. In these cases a column of water sometimes 500 feet in height is moving onwards with the tide clear and transparent above, while the lower portion holds fine sediment in suspension (a fact ascertained by soundings), when suddenly it impinges upon a bank, and its height is reduced to 300 feet. It is thus made to boil up and flow off at the surface, a process which forces up the lower strata of water charged with fine particles of mud, which in their passage from the coast had gradually sunk to a depth of 300 feet or more.—LYELL *Principles of Geology*, bk. ii, ch. 21, p. 341. (A., 1854.)

3231. STILLNESS OF TROPIC NOON —*Yet Busy Life.*—A singular contrast to the scenes I have here described [the uproar of a tropical forest by night], and which I had repeated opportunities of witnessing, is presented by the stillness which reigns within the tropics at the noontide of a day unusually sultry. . . . A thermometer observed in the shade, but brought within a few inches of the lofty mass of granite rock, rose to more than 122° F. All distant objects had wavy, undulating outlines, the optical effect of the mirage. Not a breath of air moved the dust-like sand. The sun stood in the zenith, and the effulgence of light poured upon the river, and which, owing to a gentle ripple of the waters, was brilliantly reflected, gave additional distinctness to the red haze which veiled the distance. All the rocky mounds and naked boulders were covered with large, thick-scaled iguanas, gecko-lizards, and spotted salamanders. Motionless, with uplifted heads and widely extended mouths, they seemed to inhale the heated air with ecstasy. The larger animals at such times take refuge in the deep recesses of the forest, the birds nestle beneath the foliage of the trees or in the clefts of the rocks; but if in this apparent stillness of Nature we listen closely for the faintest tones, we detect a dull, muffled sound, a buzzing and humming of insects close to the earth, in the lower strata of the atmosphere. Everything proclaims a world of active organic forces. In every shrub, in the cracked bark of trees, in the perforated ground inhabited by hymenopterous insects, life is everywhere audibly manifest. It is one of the many voices of Nature revealed to the pious and susceptible spirit of man.—HUMBOLDT *Views of Nature*, p. 200. (Bell, 1896.)

3232. STIMULUS AND INCITEMENT —*The Teacher's Great Work.*—My theory of education agrees with that of Emerson, according to which instruction is only half the battle, what he calls provocation being the other half. By this he means that power of the teacher, through the force of his character and the vitality of his thought, to bring out all the latent strength of his pupil, and to invest with interest even the driest matters of detail.—TYNDALL *Forms of Water*, pref., p. 17. (A., 1899.)

3233. STONE AGE, UNIVERSALITY OF—*Fantastic Explanations of Forgotten Implements—Everywhere Man Has Risen Only by Toil and Struggle.*—One of the chief questions to be asked about the condition of any people is whether they have metal in use for their tools and weapons. If so, they may be said to be in the metal age. If they have no copper or iron, but make their hatchets, knives, spear-heads, and other cutting and piercing instruments of stone, they are said to be in the Stone Age. Wherever such stone implements are picked up, as they often are in our own plowed fields, they prove that Stone-Age men have once dwelt in the land. It is an important fact that in every region of the inhabited world ancient stone implements are thus found in the ground, showing that at some time the inhabitants were in this respect like the modern savages. In countries where the people have long been metal-workers they have often lost all memory of what these stone things are, and tell fanciful stories to account for their being met with in

plowing or digging. One favorite notion in England and elsewhere is that the stone hatchets are " thunderbolts " fallen from the sky with the lightning flash. It has been imagined that in the east, the seat of the most ancient civilizations, some district might be found without any traces of man having lived there in a state of early rudeness, so that in this part of the world he might have been civilized from the first. But it is not so. In Assyria, Palestine, Egypt, as in other lands, one may find sharp-chipped flints, which show that here also tribes in the Stone Age once lived before the use of metal brought in higher civilization.—TYLOR *Anthropology*, ch. 1, p. 25. (A., 1899.)

3234. STONE AS BUILDING MATERIAL—*Durability of—Causes of Decay—Bending of Bunker Hill Monument.*—The solvent power of water, which attacks even glass, must in time produce an appreciable effect on the most solid material, particularly where it contains, as the water of the atmosphere always does, carbonic acid in solution. The attrition of silicious dusts, when blown against a building, or washed down its sides by rain, is evidently operative in wearing away the surface, tho the evanescent portion removed at each time may not be indicated by the nicest balance. An examination of the basin which formerly received the water from the fountain at the western entrance of the Capitol, now deposited in the Patent Office, will convince any one of the great amount of action produced principally by water charged with carbonic acid. Again, every flash of lightning not only generates nitric acid (which in solution in the rain acts on the marble), but also by its inductive effects at a distance produces chemical changes along the moist wall, which are at the present time beyond our means of estimating. Also the constant variations of temperature from day to day, and even from hour to hour, give rise to molecular motions which must affect the durability of the material of a building. Recent observations on the pendulum have shown that the Bunker Hill monument is scarcely for a moment in a state of rest, but is constantly warping and bending under the influence of the ever varying temperature of its different sides.

Moreover, as soon as the polished surface of a building is made rough from any of the causes aforementioned, the seeds of minute lichens and mosses, which are constantly floating in the atmosphere, make it a place of repose, and from the growth and decay of the microscopic plants which spring from these discoloration is produced and disintegration assisted.—HENRY *Mode of Testing Building Materials, Scientific Writings*, vol. i, p. 345. (Sm. Inst., 1886.)

3235. STONE-CUTTING, ANCIENT—*Blocks Laid without Cement.*—In ancient Egypt the masons hewed and smoothed even granite and porphyry to a finish which is envied by the architects of our own day, and the pyramids of Gizeh are as wonderful for the fine masonry of their slopes, chambers, and passages as for their prodigious size. Our modern notion of a stone building is that the blocks of stone are to be fixed together with a layer of mortar to bind them, but in the old and beautiful architecture of Egypt and Greece the faced stone blocks lie on one another, having no cement to hold them, and needing none.—TYLOR *Anthropology*, ch. 10, p. 233. (A., 1899.)

3236. STONES OF ANCIENT MONUMENTS BURIED BY WORMS—*Stonehenge.*—At Stonehenge some of the outer druidical stones are now prostrate, having fallen at a remote but unknown period, and these have become buried to a moderate depth in the ground. They are surrounded by sloping borders of turf, on which recent castings were seen. Close to one of these fallen stones, which was 17 feet long, 6 feet broad, and 28½ inches thick, a hole was dug, and here the vegetable mold was at least 9½ inches in thickness. At this depth a flint was found, and a little higher up on one side of the hole a fragment of glass. The base of the stone lay about 9½ inches beneath the level of the surrounding ground, and its upper surface 19 inches above the ground.

A hole was also dug close to a second huge stone, which in falling had broken into two pieces, and this must have happened long ago, judging from the weathered aspect of the fractured ends. The base was buried to a depth of 10 inches, as was ascertained by driving an iron skewer horizontally into the ground beneath it. The vegetable mold forming the turf-covered sloping border round the stone, on which many castings had recently been ejected, was 10 inches in thickness, and most of this mold must have been brought up by worms from beneath its base.—DARWIN *Formation of Vegetable Mold*, ch. 3, p. 45. (Hum., 1887.)

3237. STORE OF NUTRIMENT IN SEED—*A Help to Plant in Struggle for Life.*—The store of nutriment laid up within the seeds of many plants seems at first sight to have no sort of relation to other plants. But from the strong growth of young plants produced from such seeds as pease and beans, when sown in the midst of long grass, it may be suspected that the chief use of the nutriment in the seed is to favor the growth of the seedlings, while struggling with other plants growing vigorously all around.—DARWIN *Origin of Species*, ch. 3, p. 71. (Burt.)

3238. STORIES ABOUT GORILLA DISCREDITED—*His Dwelling a Mere Rude Nest—Ferocity in Attack.*—Dr. Savage repudiates the stories about the gorillas carrying off women and vanquishing elephants, and then adds:

"Their dwellings, if they may be so called, are similar to those of the chimpanzee, consisting simply of a few sticks and leafy branches, supported by the crotches and limbs of trees; they afford no shelter, and are occupied only at night.

"They are exceedingly ferocious, and always offensive in their habits, never running from man, as does the chimpanzee. They are objects of terror to the natives, and are never encountered by them except on the defensive. The few that have been captured were killed by elephant-hunters and native traders, as they came suddenly upon them while passing through the forests.

"It is said that when the male is first seen he gives a terrific yell, that resounds far and wide through the forest, something like 'kh—ah! kh—ah!' prolonged and shrill. His enormous jaws are widely opened at each expiration, his under-lip hangs over the chin, and the hairy ridge and scalp are contracted upon the brow, presenting an aspect of indescribable ferocity.

"The females and young, at the first cry, quickly disappear. He then approaches the enemy in great fury, pouring out his horrid cries in quick succession."—HUXLEY *Man's Place in Nature*, p. 211. (Hum.)

3239. STORING OF THE COAL—*Earth Once a Giant Hotbed.*—There is indisputable proof . . . that all coal beds are of vegetable origin. Geologists tell us that these coal beds were formed during an age before the earth had cooled down to the temperature that it has at the present time—an age when vegetation was forced by the internal heat of the earth instead of having to receive all its warmth from the sun's rays, as we do now. Some of our readers are familiar with what is commonly termed a hotbed. A hotbed is made by putting soil on top of substances that will ferment and create heat underneath the soil. This heat from beneath will force vegetation and cause a much larger growth than there will be if left to the sun's rays alone. During the carboniferous age the earth was a great hotbed.—ELISHA GRAY *Nature's Miracles*, vol. i, ch. 3, p. 24. (F. H. & H., 1900.)

3240. STORMS MILD BY COMPARISON—*Earth's Fiercest Tempests Compared with Hurricanes on Jupiter.*—Examined by a powerful telescope, Jupiter shows all the signs of the most tremendous atmospheric disturbances. There are great bands of clouds all around him, so arranged as to imply the existence of very strong winds resembling our trade-winds. But these cloud zones change sometimes so rapidly in shape as to show that either some of the clouds have rapidly discharged their contents in rain and new clouds have been very rapidly formed, or else that great cloud-masses have been carried along with enormous rapidity by winds of hurricane force. These motions of cloud-masses on Jupiter, when interpreted by what we know of the real dimensions of Jupiter, have been found to indicate the existence of winds blowing at the rate of nearly 200 miles per hour [contrasted with the rarely attained speed of ninety miles an hour on earth]. . . . Our terrestrial storms rage sometimes for five or six days in successsion, but this is very unusual. Ordinarily, the fiercest storm blows itself out in less than three days. Now, Jovian hurricanes have been known to last for six or seven weeks.—PROCTOR *Expanse of Heaven*, p. 79. (L. G. & Co., 1897.)

3241. STORMS ON THE SUN—*Torrents of Flaming Hydrogen Thousands of Miles High.*—Outside the opaque photosphere the sun appears surrounded by a layer of transparent gases, which are hot enough to show in the spectrum bright colored lines, and are hence called the chromosphere. They show the bright lines of hydrogen, of sodium, of magnesium, and iron. In these layers of gas and of vapor about the sun enormous storms occur, which are as much greater than those of our earth in extent and in velocity as the sun is greater than the earth. Currents of ignited hydrogen burst out several thousands of miles high, like gigantic jets or tongues of flame, with clouds of smoke above them. These structures could formerly only be viewed at the time of a total eclipse of the sun, forming what were called the rose-red protuberances. We now possess a method, devised by MM. Jansen and Lockyer, by which they may at any time be seen by the aid of the spectroscope.—HELMHOLTZ *Popular Lectures*, lect. 4, p. 158. (L. G. & Co., 1898.)

3242. ——— ——— *Tumult and Uproar behind Beneficence—The Soundless Depths of Space.*—We know something of the processes at work upon our own sun. We know of storms raging there, in which fiery vapor masses, tens of thousands of miles in breadth, sweep onward at a rate exceeding a hundredfold in velocity the swiftest rush of our express trains. We see matter flung forth from the depths beneath the sun's blazing surface to a height exceeding ten- and twenty-fold the diameter of the globe on which we live. And we know that these tremendous motions, tho they seem to take place silently, must in reality be accompanied with a tumult and uproar altogether inconceivable. We know that precisely as distance so reduces the seeming dimensions of these vapor-masses, and their seeming rate of motion, that even in the most powerful telescopes they appear like the tiniest of the clouds which fleck the bosom of the summer sky, and change as slowly in their seeming shape; so distance partly, and partly the absence of a medium to convey the sound, reduces to utter silence a noise and clangor compared with which the roar of the hurricane, the crash of the thunderbolt, the bellowing of the volcano, and the hideous groaning of

the earthquake are as absolute silence.—PROCTOR *Expanse of Heaven*, p. 300. (L. G. & Co., 1897.)

3243. STRAIN OF DESIRE TOWARD THE UNKNOWN—*Recollection by Effort.*—Whenever we seek to recall something forgotten, or to state the reason for a judgment which we have made intuitively, the desire strains and presses in a direction which it feels to be right, but towards a point which it is unable to see. In short, the absence of an item is a determinant of our representations quite as positive as its presence can ever be.—JAMES *Psychology*, vol. i, ch. 14, p. 584. (H. H. & Co., 1899.)

3244. STRATA ARRANGED FOR GEOLOGIST'S STUDY — *Granite Wedges Forced through Sandstone.*—Imagine a large wedge forced from below through a sheet of thick ice on a river or pond. First the ice rises in an angle, that becomes sharper and higher as the wedge rises; then it cracks and opens, presenting its upturned edges on both sides, and through comes the wedge. And this is a very different process, be it observed, from what takes place when the ice merely cracks and the water issues through the crack. In the one case there is a rent and water diffused over the surface; in the other there is the projecting wedge, flanked by the upturned edges of the ice; and these edges, of course, serve as indices to decide regarding the ice's thickness and the various layers of which it is composed. Now, such are the phenomena exhibited by the wedge-like granitic ridge. The lower Old Red Sandstone, tilted up against it on both sides, at an angle of about eighty, exhibits in some parts a section of well-nigh two thousand feet, stretching from the lower conglomerate to the soft, unfossiliferous sandstone, which forms in Ross and Cromarty the upper beds of the formation. There is a mighty advantage to the geologist in this arrangement. When books are packed up in a deep box or chest we have to raise the upper tier ere we can see the tier below, and this second tier ere we can arrive at a third, and so on to the bottom. But when well arranged on the shelves of a library, we have merely to run the eye along their lettered backs, and we can thus form an acquaintance with them at a glance, which in the other case would have cost us a good deal of trouble. Now, in the neighborhood of this granitic wedge, or wall, the strata are arranged, not like books in a box—such was their original position—but like books on the shelves of a library. They have been unpacked and arranged by the uptilting agent, and the knowledge of them, which could only have been attained in their first circumstances by perforating them with a shaft of immense depth, may now be acquired simply by passing over their edges. A morning's saunter gives us what would have cost, but for the upheaving granite, the labor of a hundred miners for five years.—MILLER *The Old Red Sandstone*, ch. 6, p. 98. (G. & L., 1851.)

3245. STRATA OF A MOUNTAIN—*An Amended Illustration.*—The geologists of the school of Werner used to illustrate what we may term the anatomy of the earth, as seen through the spectacles of their system, by an onion and its coats; they represented the globe as a central nucleus, encircled by concentric coverings, each covering constituting a geological formation. The onion, through the introduction of a better school, has become obsolete as an illustration; but to restore it again, tho for another purpose, we have merely to cut it through the middle, and turn downwards the planes formed by the knife. It then represents, with its coats, hills . . . such as Ben Nevis, ere the granite had perforated the gneiss, or the porphyry broken through the granite.—MILLER *The Old Red Sandstone*, ch. 2, p. 25. (G. & L., 1851.)

3246. STRATEGY OF DEER PROTECTING FAWN—*Fawn's Instinct of Flight and Concealment.*—I have had frequent opportunities of observing the young, from one to three days old, of the *Cervus campestris*—the common deer of the pampas—and the perfection of its instincts at that tender age seem very wonderful in a ruminant. When the doe with fawn is approached by a horseman, even when accompanied with dogs, she stands perfectly motionless, gazing fixedly at the enemy, the fawn motionless at her side; and suddenly, as if at a preconcerted signal, the fawn rushes directly away from her at its utmost speed, and going to a distance of six hundred to a thousand yards conceals itself in a hollow in the ground or among the long grass, lying down very close with neck stretched out horizontally, and will thus remain until sought by the dam. When very young, if found in its hiding-place, it will allow itself to be taken, making no further effort to escape. After the fawn has run away the doe still maintains her statuesque attitude, as if resolved to await the onset, and only when the dogs are close to her she also rushes away, but invariably in a direction as nearly opposite to that taken by the fawn as possible. At first she runs slowly, with a limping gait, and frequently pausing, as if to entice her enemies on, like a partridge, duck, or plover when driven from its young; but as they begin to press her more closely her speed increases, becoming greater the further she succeeds in leading them from the starting-point.

The alarm-cry of this deer is a peculiar whistling bark, a low but far-reaching sound; but when approaching a doe with young I have never been able to hear it, nor have I seen any movement on the part of the doe. Yet it is clear that in some mysterious way she inspires the fawn with sudden, violent fear, while the fawn, on its

side, instead of being affected like the young in other mammals, and sticking closer to its mother, acts in a contrary way, and runs from her.—HUDSON *Naturalist in La Plata*, ch. 6, p. 110. (C. & H., 1895.)

3247. STREAM OF LAVA HARDENED INTO STONE—*A Frozen Cataract—Eruption of Etna.*—The lava [flowing from Etna in 1669], after overflowing fourteen towns and villages, some having a population of between three and four thousand inhabitants, arrived at length at the walls of Catania. These had been purposely raised to protect the city, but the burning flood accumulated till it rose to the top of the rampart, which was sixty feet in height, and then it fell in a fiery cascade and overwhelmed part of the city. The wall, however, was not thrown down, but was discovered long afterwards by excavations made in the rock by the Prince of Biscari, so that the traveler may now see the solid lava curling over the top of the rampart as if still in the very act of falling.—LYELL *Principles of Geology*, bk. ii, ch. 25, p. 400. (A., 1854.)

3248. ——— ——— *Spectators Almost Entrapped—Hill Melted Down.*—As another illustration of the solidity of the walls of an advancing lava-stream, I may mention an adventure related by Recupero, who, in 1766, had ascended a small hill formed of ancient volcanic matter, to behold the slow and gradual approach of a fiery current, two miles and a half broad, when suddenly two small threads of liquid matter issuing from a crevice detached themselves from the main stream and ran rapidly towards the hill. He and his guide had just time to escape, when they saw the hill, which was fifty feet in height, surrounded, and in a quarter of an hour melted down into the burning mass, so as to flow on with it.—LYELL *Principles of Geology*, bk. ii, ch. 25, p. 401. (A., 1854.)

3249. STRENGTH DEVELOPED BY RESISTANCE—*Growing Plants Made Stronger by Stress and Strain.*—Many commonplace facts indicate that the mechanical strains to which upright growing plants are exposed themselves cause increase of the dense deposits by which such plants are enabled to resist such strains. There is the fact that the massiveness of a tree-trunk varies according to the stress habitually put upon it. . . . A tree trained against a wall has a less bulky stem than a tree of the same kind growing unsupported; and between the long, weak branches of the one and the stiff ones of the other there are decided contrasts. Garden plants, which when held up by tying them to sticks have weaker stems than when they are unpropped, and sink down if their props are taken away. . . . Trees growing on inclined rocky surfaces send into crevices that afford little moisture or nutriment roots which nevertheless become thick where they are so directed as to bear great strains.—SPENCER *Biology*, pt. iv, ch. 4, p. 275. (A., 1900.)

3250. ——— ——— *Strongest Corals Grow in Hardest Surf—Vital Energies Conquer Mechanical Power.*—It has been a question with some naturalists which part of a reef is most favorable to the growth of coral. The great mounds of living porites and of millepora round Keeling atoll occur exclusively on the extreme verge of the reef, which is washed by a constant succession of breakers; and living coral nowhere else forms solid masses. At the Marshall Islands the larger kinds of coral, . . . "which form rocks measuring several fathoms in thickness," prefer . . . the most violent surf. I have stated that the outer margin of the Maldiva atolls consists of living corals (some of which, if not all, are of the same species with those at Keeling atoll), and here the surf is so tremendous that even large ships have been thrown, by a single heave of the sea, high and dry on the reef, all on board thus escaping with their lives. . . . The vital energies of the corals conquer the mechanical power of the waves; and the large fragments of reef torn up by every storm are replaced by the slow but steady growth of the innumerable polypifers which form the living zone on its outer edge. . . . It is certain that the strongest and most massive corals flourish where most exposed.—DARWIN *Coral Reefs*, ch. 4, p. 85. (A., 1900.)

3251. STRENGTH, MAN'S, PROPORTIONED TO EARTHLY NEEDS—*Weakness of Gravity on the Moon—Cyclopean Amphitheaters and Volcanoes.*—Gravity at the surface of the moon is weaker than with us; if we represent by 1,000 the force which causes objects to adhere to the terrestrial globe, that on the moon would be represented by 164. Hence, objects weigh there six times less than here; they are attracted six times less strongly. A stone weighing one pound, if transported to the moon, would not weigh more than 3 ounces. A man weighing 11 stone on our planet would not weigh there more than 26 pounds. If we imagine a man transported to our satellite, if we suppose, moreover, that his muscular powers would remain the same in this new abode, he would be able to raise weights five to six times heavier than on the earth, and his own body itself would seem to be five or six times lighter. The least muscular effort would enable him to spring to enormous heights or to run with the speed of a locomotive. [It must be observed] what a considerable part this weakness of gravity has played in the topographical organization of the lunar world, by permitting the volcanoes to pile up giant mountains on Cyclopean amphitheaters, and with a powerful hand to toss Alps upon Pyrenees.—FLAMMARION *Popular Astronomy*, bk. ii, ch. 3, p. 110. (A.)

3252. STRENGTH OF STRUCTURE ADAPTED TO RESISTANCE—*Shells of Plymouth Breakwater—Weakest against Least Exposure.*—The same species of mollusk has often a shell comparatively weak and thin, or a shell comparatively robust and strong, according as it lies in tranquil or in stormy water. The shell which is much exposed needs to be stronger than the shell which is less exposed. But it is obvious that the mere fact of the need cannot supply the thing needed, unless by the adjustment of some machinery for the purpose. How the vital forces of the mollusk can thus be made to work to order, under a change of external conditions, we do not know. But we do know, as a matter of fact, that the shell is thickened and strengthened according as it needs resisting power. This result does not appear to arise from any difference in the amount of lime held in solution in the water, but from some power in the secreting organs of the animal to appropriate more or less of it according to its own need. The effects of this power are seen where there is no difference of condition except difference of exposure. It is said that they are observable, for example, in the shells which lie on the different sides of Plymouth breakwater—the sheltered side and the exposed side. The same power of adaptation is seen in many other forms. Trees which are most exposed to the blast are the most strongly anchored in the soil. Limbs which are the most used are the most developed. Organs which are in constant use are strengthened, whilst organs in habitual disuse have a tendency to become weaker.—ARGYLL *Reign of Law,* ch. 5, p. 128. (Burt.)

3253. STRENGTH, SURPRISING—*Physical Effect of Emotion.*—Of the almost superhuman strength and agility with which the body seems endowed, when the whole energy is concentrated upon some nervo-muscular effort, especially under the influence of an overpowering emotion, the following remarkable example has been communicated to the writer by a gentleman on whom he can place full reliance, and who was personally cognizant of the fact: An old cook-maid, tottering with age, having heard an alarm of fire, seized an enormous box containing her whole property, and ran downstairs with it as easily as she would have carried a dish of meat. After the fire had been extinguished she could not lift the box a hair's breadth from the ground, and it required two men to convey it upstairs again.—CARPENTER *Mental Physiology,* ch. 7, p. 328. (A., 1900.)

3254. STRENGTH UNDERMINED—*White Ants Eat Out the Substance of Timber from Within.*—Either from the desire to remain undiscovered [according to Büchner], or from their liking for darkness, they [the white ants] have the remarkable habit of destroying and gnawing everything from within outwards, and of leaving the outside shell standing, so that from the outside appearance the dangerous state of the inside is not perceptible. If, for instance, they have destroyed a table or other piece of household furniture, in which they always manage from the ground upwards to hit exactly the places on which the feet of the article rest, the table looks perfectly uninjured outside, and people are quite astonished when it breaks down under the slightest pressure. The whole inside is eaten away, and only the thinnest shell is left standing. If fruits are lying on the table they also are eaten out from the exact spot on which they rest on the surface of the table. In similar fashion things consisting wholly of wood, such as wooden ships, trees, etc., are destroyed by them so that they finally break in without any one having noticed the mischief.—ROMANES *Animal Intelligence,* ch. 5, p. 201. (A., 1899.)

3255. STRESS OF EMOTION MAKES PAST SEEM DISTANT—*A Great Sorrow Quickly Seems Old.*—Our representation of the position of a given event in the past is . . . determined by the movement of imagination in going back to it from the present. And this is the same thing as to say that it depends on our retrospective sense of the intervening space. That is to say, the sense of distance in time, as in space, is the recognition of a term to a movement. . . . A very recent event, bringing with it a deep mental shock and a rapid stirring of wide tracts of feeling and thought, may get to look old in a marvelously short space of time. An announcement of the loss of a dear friend, when sudden and deeply agitating, will seem remote even after an hour of such intense emotional experience.—SULLY *Illusions,* ch. 10, p. 254. (A., 1897.)

3256. STRIFE IN NATURE—*The Struggle for Existence—Parasites Have Brought Famine to Man.*—In thus obtaining possession of the earth by conquest [of animals], and defending our acquisitions by force, we exercise no exclusive prerogative. Every species which has spread itself from a small point over a wide area must, in like manner, have marked its progress by the diminution or the entire extirpation of some other, and must maintain its ground by a successful struggle against the encroachments of other plants and animals. That minute parasitic plant, called "the rust" in wheat, has, like the Hessian fly, the locust, and the aphis, caused famines ere now amongst the "lords of the creation." The most insignificant and diminutive species, whether in the animal or vegetable kingdom, have each slaughtered their thousands, as they disseminated themselves over the globe, as well as the lion, when first it spread itself over the tropical regions of Africa.—LYELL *Principles of Geology,* bk. iii, ch. 41, p. 688. (A., 1854.)

3257. STRUCTURE OF THE HEAVENS, COMPLICATED—*Nebulæ of Many Types—The Magellanic Clouds—Contrasted with Starless Spaces, the "Coal Sacks."*—Mysterious objects [the nebulæ], voices of the past, prophecies of the future, these soft and pale gleams open to the mind new perspectives in infinitude; the first telescopic observers of the sky, who treasured the memory of the empyrean, described them as openings through the celestial vault, permitting our gaze to penetrate to the light of Paradise. The types on which we have fixed our attention give still but an incomplete idea. We should add the lenticular and elliptical nebulæ; the perforated nebulæ; nebulous rays; the great cloud of Magellan, at 20° from the south pole, which contains 291 nebulæ, 46 stellar clusters, and 582 stars, and covers 42 square degrees of the sky; the smaller cloud, which occupies 10 square degrees, contains 200 stars, 37 nebulæ, and 7 clusters; and not far from that the "coal sacks," regions entirely void of stars, yawning openings in the sidereal universe, as if a waterspout had devastated them; and, again, the faintest nebulæ lost in the depths of the sky, whose light would take, according to the Herschelian estimates, two millions of years to reach us!—FLAMMARION *Popular Astronomy*, bk. vi, ch. 10, p. 665. (A.)

3258. STRUGGLE AND CONFLICT BEHIND THE BEAUTY AND ORDER OF NATURE—To most persons Nature appears calm, orderly, and peaceful. They see the birds singing in the trees, the insects hovering over the flowers, the squirrel climbing among the tree-tops, and all living things in the possession of health and vigor and in the enjoyment of a sunny existence. But they do not see and hardly ever think of the means by which this beauty and harmony and enjoyment are brought about. They do not see the constant and daily search after food, the failure to obtain which means weakness or death; the constant effort to escape enemies; the ever-recurring struggle against the forces of Nature. This daily and hourly struggle, the incessant warfare, is nevertheless the very means by which much of the beauty and harmony and enjoyment in Nature are produced, and also affords one of the most important elements in bringing about the origin of species.—WALLACE *Darwinism*, ch. 2, p. 10. (Hum.)

3259. ——— ——— *Among All Plants—The More Vigorous Choke the Weaker (Matt. xiii, 7).*—"All the plants of a given country," says De Candolle, in his usual spirited style, "are at war one with another. The first which establish themselves by chance in a particular spot tend, by the mere occupancy of space, to exclude other species—the greater choke the smaller; the longest livers replace those which last for a shorter period; the more prolific gradually make themselves masters of the ground which species multiplying more slowly would otherwise fill." In this continual strife it is not always the resources of the plant itself which enable it to maintain or extend its ground. Its success depends, in a great measure, on the number of its foes or allies among the animals and plants inhabiting the same region. Thus, for example, an herb which loves the shade may multiply, if some tree with spreading boughs and dense foliage flourish in the neighborhood. Another, which, if unassisted, would be overpowered by the rank growth of some hardy competitor, is secure because its leaves are unpalatable to cattle, which, on the other hand, annually crop down its antagonist, and rarely suffer it to ripen its seed.—LYELL *Principles of Geology*, bk. iii, ch. 40, p. 670. (A., 1854.)

3260. STRUGGLE FOR LIFE, THE—*Among Ants.*—Almost everything is invaded by the structures of ants. Where there are no real nests there are underground passages and galleries, open roads, covered ways; or, at least, the inhabitants of neighboring nests are out scouting, contending with one another for the possession of plants containing plant-lice and cochineal kermes, for the possession of the trees, the flowers, and the insect plunder. . . . Ants certainly, no less than men, fancy themselves the lords of creation; for, owing to their social organization, their numbers, and their courage, they have few foes to fear. Their most formidable foes are other ants, just as men are the worst foes of men. In the tropical world the struggle for existence is much fiercer than with us, and the ants, with their immense number of species, play a much more important part. Their nest-structures are correspondingly more varied there, displaying far more singular and complicated adaptations as the result of the struggle for life.—FOREL *Ants' Nests (Report of Smithsonian Institution, 1894*, p. 503).

3261. ——— ——— *Among Bacteria.*—There is in these media [water and sewage] in Nature a keen struggle for the survival of the fittest bacteria for each special medium. In a carcass it is the same. If saprophytic bacteria [bacteria of decomposition] are present with pathogenic [disease-producing], there is a struggle for the survival of the latter. Now whilst this is in part due to a competition owing to a limited food supply and an unlimited population, as occurs in other spheres, it is also due in part to the inimical influence of the chemical products of the one species upon the life of the bacteria of the other species. Moreover, in one culture medium, as Cast has pointed out, two species will often not grow. When Pasteur found that exposure to air attenuated his cultures, he pointed out that it was not the air *per se* that hindered his growth, but it was the introduc-

tion of other species which competed with the original.—NEWMAN *Bacteria*, ch. 1, p. 34. (G. P. P., 1899.)

3262. ——— ——— *Conflict Most Severe between Allied Forms.*—The dependency of one organic being on another, as of a parasite on its prey, lies generally between beings remote in the scale of Nature. This is likewise sometimes the case with those which may be strictly said to struggle with each other for existence, as in the case of locusts and grass-feeding quadrupeds. But the struggle [for life] will almost invariably be most severe between the individuals of the same species, for they frequent the same districts, require the same food, and are exposed to the same dangers. —DARWIN *Origin of Species*, ch. 3, p. 69. (Burt.)

3263. ——— ——— *Family Relieves—Duties Distributed—Character Developed.* —Great as are the physical advantages of the family, the ethical uses, even in the early days of its existence, place this institution at the head of all the creations of evolution. For the family is not only its greatest creation, but its greatest instrument for further creation. The ethical changes begin almost the moment it is formed. One immediate effect, for instance, of the formation of family groups was to take off from any single individual the perpetual strain of the struggle for life. The family as a whole must sometimes fight, but the responsibility and the duty are now distributed, and those who were once solely preoccupied with the personal struggle will have respites during which other things will occupy their minds. Attention thus called off from environing enemies, the members of the family will, as it were, discover one another. New relations among them will spring up, new adjustments to one another's presence and to one another's needs, and hitherto unknown elements of character will be gradually called to the surface.—DRUMMOND *Ascent of Man*, ch. 9, p. 310. (J. P., 1900.)

3264. ——— ——— *Its Intensity Transcends Calculation.*—Every one has heard that when an American forest is cut down a very different vegetation springs up; but it has been observed that ancient Indian ruins in the southern United States, which must formerly have been cleared of trees, now display the same beautiful diversity and proportion of kinds as in the surrounding virgin forests. What a struggle must have gone on during long centuries between the several kinds of trees, each annually scattering its seeds by the thousand; what war between insect and insect, between insects, snails, and other animals, with birds and beasts of prey, all striving to increase, all feeding on each other, or on the trees, their seeds and seedlings, or on the other plants which first clothed the ground and thus checked the growth of the trees! Throw up a handful of feathers and all fall to the ground according to definite laws; but how simple is the problem where each shall fall compared to that of the action and reaction of the innumerable plants and animals which have determined, in the course of centuries, the proportional numbers and kinds of trees now growing on the old Indian ruins!—DARWIN *Origin of Species*, ch. 3, p. 69. (Burt.)

3265. ——— ——— *Not the Only Element in Evolution—The "Villain" Not the Only Actor in the Drama.*—That the struggle for life has been a prominent actor in the drama is certain. Further research has only deepened the impression of the magnitude and universality of this great and far-reaching law. But that it is the sole or even the main agent in the process of evolution must be denied. Creation is a drama, and no drama was ever put upon the stage with only one actor. The struggle for life is the "villain" of the piece, no more; and, like the "villain" in the play, its chief function is to react upon the other players for higher ends.—DRUMMOND *Ascent of Man*, int., p. 12. (J. P., 1900.)

3266. ——— ——— *Painfulness of, among the Lower Animals—Less Painful than We Imagine—Nature Takes by Force the Sacrifice Not Freely Made.*—The probabilities are that the struggle for life in the lower creation is, to say the least, less painful than it looks. Whether we regard the dulness of the states of consciousness among lower animals, or the fact that the condition of danger must become habitual, or that death when it comes is sudden, and unaccompanied by that anticipation which gives it its chief dread to man, we must assume that whatever the struggle for life subjectively means to the lower animals, it can never approach in terror what it means to us. And as to putting any moral content into it, until a late stage in the world's development, that is not to be thought of. Judged of even by later standards, there is much to relieve one's first unfavorable impression. With exceptions, the fight is a fair fight. As a rule, there is no hate in it, but only hunger. It is seldom prolonged and seldom wanton. As to the manner of death, it is generally sudden. As to the fact of death, all animals must die. As to the meaning of an existence prematurely closed, it is better to be to be eaten than not to be at all. And, as to the last result, it is better to be eaten out of the world and, dying, help another to live, than pollute the world by lingering decay. The most, after all, that can be done with life is to give it to others. Till Nature taught her creatures of their own free will to offer the sacrifice, is it strange that she took it by force?—DRUMMOND *Ascent of Man*, ch. 6, p. 203. (J. P., 1900.)

3267. ——— ——— *Subordinated to Higher Aims—The Evolution of Motherhood—The Struggle for Another's Life Begun.*—Watch any higher animal at that most critical of all hours—for itself, and for its species—the hour when it gives birth to another creature like itself. Pass over the purely physiological processes of birth; observe the behavior of the animal-mother in presence of the new and helpless life which palpitates before her. There it lies, trembling in the balance between life and death. Hunger tortures it; cold threatens it; danger besets it; its blind existence hangs by a thread. There is the opportunity of evolution. There is an opening appointed in the physical order for the introduction of a moral order. If there is more in Nature than the selfish struggle for life the secret can now be told. Hitherto, the world belonged to the food-seeker, the self-seeker, the struggler for life, the father. Now is the hour of the mother. And, animal tho she be, she rises to her task. And that hour, as she ministers to her young, becomes to her, and to the world, the hour of its holiest birth.—Drummond *Ascent of Man*, p. 17. (J. P., 1900.)

3268. STUDENT OF FACTS CAN ALONE DETERMINE THEORY—But none have a right to question either the sanity or the sanctity of such investigations, still less to dismiss them idly on a priori grounds, till they have approached the practical problem for themselves, and heard at least the first few relevant words from Nature. For one has only to move for a little among the facts to see what a world of interest lies here, and to be forced to hold the judgment in suspense till the sciences at work upon the problem have further shaped their verdict.—Drummond *Ascent of Man*, ch. 4, p. 121. (J. P., 1900.)

3269. STUDENTS OF PURE SCIENCE MAKE DISCOVERIES—*Others Make Industrial Application.*—Cuvier, the great comparative anatomist, writes thus . . . : "These grand, practical innovations are the mere applications of truths of a higher order, not sought with a practical intent, but pursued for their own sake, and solely through an ardor for knowledge. Those who applied them could not have discovered them; those who discovered them had no inclination to pursue them to a practical end. Engaged in the high regions whither their thought had carried them, they hardly perceived these practical issues, tho born of their own deeds. These rising workshops, these peopled colonies, those ships which furrow the seas—this abundance, this luxury, this tumult—all this comes from discoverers in science, and it all remains strange to them. At the point where science merges into practise they abandon it; it concerns them no more."—Tyndall *Lectures on Light*, p. 223. (A., 1898.)

3270. STUDY, FAVORITE, MENTAL BENEFIT OF—*Biology Gives the Mind Breadth and Tone.*—Mr. Hamerton has well said, "To have one favorite study, and live in it with happy familiarity, and cultivate every portion of it diligently and lovingly, as a small yeoman proprietor cultivates his own land, this, as to study, at least, is the most enviable intellectual life." And if a study should be sought for which shall most pleasantly aid in the cultivation of the inner life just described it will assuredly be found more readily within the domain of biology than in any other department of human knowledge. To act as such a mental stimulant; to effectually prevent the occurrence of that miserable disease of female mental existence—ennui; to give the mind breadth and tone from the beginning of its cultivation—such are the benefits I claim for the school study of biology, carried in its natural development into the after-life of the pupil of either sex.—Andrew Wilson *Biology in Education*, p. 25. (Hum., 1888.)

3271. STUDY OF NATURE LIMITED BY TRADITIONAL BELIEFS—*Existence of Sun-spots Denied—The Sun Studied by Night in Aristotle.*—It was Father Scheiner, a Jesuit of Ingolstadt, who first effectually called attention to the sun-spots, and this, so to say, in spite of himself and in spite of his superior. The day-star was regarded and honored as the purest symbol of celestial incorruptibility, and the official savants of that age would never have dared to consent to the admission of these spots. It would have been then a crime of high treason, and dogma itself would have appeared to be compromised. After his repeated observations, which would not permit him to doubt their existence, our Jesuit went to consult the provincial father of his order, a zealous peripatetic philosopher, who refused to believe it. "I have read the whole of my Aristotle several times," he replied to Scheiner, "and I can assure you that I have found nothing similar there. Go, my son," added he, dismissing him; "quiet yourself, and be certain that there are defects in your glasses or in your eyes which you take for spots on the sun." They even say that he passed the night in ascertaining the state of the day-star! At this epoch academical routine still domineered over the study of Nature. Very fortunately for science, unfettered minds would observe: what Scheiner did in Germany, Galileo did in Italy, and the solar spots were verified as facts by all those who wished to see them.—Flammarion *Popular Astronomy*, bk. iii, ch. 3, p. 253. (A.)

3272. STUPIDITY OF INSTINCT—*Cats Endlessly Baffled by Same Trick—All Experience Vain.*—A curious instance . . . was brought to my notice . . . by one of my neighbors, a native. His children had made the discovery that some excite-

ment and fun were to be had by placing a long, hollow stalk of the giant thistle with a mouse in it—and every hollow stalk at this time had one for a tenant—before a cat, and then watching her movements. Smelling her prey, she would spring at one end of the stalk—the end towards which the mouse would be moving at the same time—but would catch nothing; for the mouse, instead of running out, would turn back to run to the other end, whereupon the cat, all excitement, would jump there to seize it; and so the contest would continue for a long time, an exhibition of the cleverness and the stupidity of instinct, both of the pursuer and the pursued.—HUDSON *Naturalist in La Plata*, ch. 3, p. 61. (C. & H., 1895.)

3273. ——— ——— *Example of Contrasted Intelligence.*—There were several cats at the house, and all acted in the same way [as that described in paragraph 3272] except one. When a stalk was placed before this cat, instead of becoming excited like the others, it went quickly to one end and smelt at the opening; then, satisfied that its prey was inside, it deliberately bit a long piece out of the stalk with its teeth, then another strip, and so on progressively, until the entire stick had been opened up to within six or eight inches of the further end, when the mouse came out and was caught. Every stalk placed before this cat was demolished in the same businesslike way; but the other cats, tho they were made to look on while the stick was being broken up by their fellow, could never learn the trick.—HUDSON *Naturalist in La Plata*, ch. 3, p. 61. (C. & H., 1895.)

3274. ——— ——— *No Power of Adaptation to New Needs and Perils.*—The nature of this lizard's food [the Amblyrhyncus of the Galapagos Islands], as well as the structure of its tail and feet, and the fact of its having been seen voluntarily swimming out at sea, absolutely prove its aquatic habits; yet there is in this respect one strange anomaly, namely, that when frightened it will not enter the water. Hence it is easy to drive these lizards down to any little point overhanging the sea, where they will sooner allow a person to catch hold of their tails than jump into the water. . . . I threw one several times as far as I could into a deep pool left by the retiring tide, but it invariably returned in a direct line to the spot where I stood. It swam near the bottom, with a very graceful and rapid movement, and occasionally aided itself over the uneven ground with its feet. . . . I several times caught this same lizard by driving it down to a point, and tho possessed of such perfect powers of diving and swimming, nothing would induce it to enter the water; and as often as I threw it in it returned in the manner above described. Perhaps this singular piece of apparent stupidity may be accounted for by the circumstance that this reptile has no enemy whatever on shore, whereas at sea it must often fall a prey to the numerous sharks. Hence, probably, urged by a fixed and hereditary instinct that the shore is its place of safety, whatever the emergency may be, it there takes refuge.—DARWIN *Naturalist's Voyage around the World*, ch. 17, p. 386. (A., 1893.)

3275. STUPIDITY OF THE HORSE —*Utility of Limited Intelligence.*—The horse is a densely stupid animal, as far as everything goes except contiguous association. We reckon him intelligent, partly because he looks so handsome, partly because he has such a wonderful faculty of contiguous association and can be so quickly molded into a mass of set habits. Had he anything of reasoning intelligence he would be a less faithful slave than he is.—JAMES *Psychology*, vol. ii, ch. 22, p. 353. (H. H. & Co., 1899.)

3276. SUBLIMITY AND BEAUTY ARE IN THE SOUL—To Switzerland belongs the rock—to the early climber, competent to enjoy them, belong the sublimity and beauty of mass, form, color, and grouping. And still the outward splendor is by no means all. "In the midst of a puddly moor," says Emerson, "I am afraid to say how glad I am," which is a strong way of affirming the influence of the inner man as regards the enjoyment of external Nature. And surely the inner man is a high factor in the effect. The magnificence of the world outside suffices not. Like light falling upon the polished plate of the photographer, the glory of Nature, to be felt, must descend upon a soul prepared to receive its image and superscription.—TYNDALL *Hours of Exercise in the Alps*, ch. 25, p. 301. (A., 1898.)

3277. SUBLIMITY OF VASTNESS—*The Steppes Once the Bottom of an Inland Sea.*—The steppes themselves [were once] the bottom of some vast inland sea. Even now illusion often recalls, in the obscurity of night, these images of a former age. For when the guiding constellations illumine the margin of the plain with their rapidly rising and setting beams, or when their flickering forms are reflected in the lower stratum of undulating vapor, a shoreless ocean seems spread before us. Like a limitless expanse of waters, the steppe fills the mind with a sense of the infinite, and the soul, freed from the sensuous impressions of space, expands with spiritual emotions of a higher order. But the aspect of the ocean, its bright surface diversified with rippling or gently swelling waves, is productive of pleasurable sensations, while the steppe lies stretched before us cold and monotonous, like the naked, stony crust of some desolate planet.—HUMBOLDT *Views of Nature*, p. 1. (Bell, 1896.)

3278. SUBMERGENCE AND ELEVATION OF CONTINENTS—*Marine Fossils in Inland Rocks—Warm Seasons in Arctic Regions.*—The greater part of the marine

fossils known to us are from rocks now raised up in our continents, and they lived at periods when the continents were submerged. Now, in geological time these periods of submergence alternated with others of elevation; and it is manifest that each period of continental submergence gave scope for the introduction of numbers of new marine species, while each continental elevation, on the other hand, gave opportunity for the increase of land life. Further, periods when a warm climate prevailed in the arctic regions—periods when plants such as now live in temperate regions could enjoy six months of continuous sunshine—were eminently favorable to the development of such plants, and were utilized for the introduction of new floras, which subsequently spread to the southward. Thus we see physical changes occurring in an orderly succession, and made subservient to the progress of life.—DAWSON *Facts and Fancies in Modern Science*, lect. 3, p. 125. (A. B. P. S.)

3279. ——— ——— *The Glacial Period —The Walrus Swimming among Sunken Fir-trees of England.*—There is a writing upon the wall of cliffs at Cromer, and whoso runs may read it. It tells us, with an authority which cannot be impeached, that the ancient sea-bed of the chalk sea was raised up and remained dry land until it was covered with forest, stocked with the great game whose spoils have rejoiced your geologists. . . . That dry land, with the bones and teeth of generations of long-lived elephants, hidden away among the gnarled roots and dry leaves of its ancient trees, sank gradually to the bottom of the icy sea, which covered it with huge masses of drift and boulder clay. Sea-beasts, such as the walrus, now restricted to the extreme north, paddled about where birds had twittered among the topmost twigs of the fir-trees. How long this state of things endured we know not, but at length it came to an end. The upheaved glacial mud hardened into the soil of modern Norfolk. Forests grew once more, the wolf and the beaver replaced the reindeer and the elephant; and at length what we call the history of England dawned. —HUXLEY *Lay Sermons*, serm. 9, p. 194. (G. P. P., 1899.)

3280. SUBSIDENCE, GRADUAL, OF EARTH'S CRUST—*Coral Islands a Proof.* —There are many large spaces of ocean, without any high land, interspersed with reefs and islets formed by the growth of those kinds of coral which cannot live at great depths; and the existence of these reefs and low islets in such numbers and at such distant points is inexplicable, excepting on the theory that their rocky bases slowly and successively sank beneath the level of the sea, whilst the corals continued to grow upwards. No positive facts are opposed to this view, and some direct evidence, as well as general considerations, render it probable.—DARWIN *Coral Reefs*, ch. 5, p. 132. (A., 1900.)

3281. SUBSIDENCE OF GRECIAN COAST—*Deluge of Samothrace—Capitals of Columns in Fishing Nets.*—As to the deluge of Samothrace, which is generally referred to a distinct date, it appears that the shores of that small island and the adjoining mainland of Asia were inundated by the sea. Diodorus Siculus says that the inhabitants had time to take refuge in the mountains and save themselves by flight; he also relates that long after the event the fishermen of the island drew up in their nets the capitals of columns, which were the remains of cities submerged by that terrible catastrophe. These statements scarcely leave any doubt that there occurred, at the period alluded to, a subsidence of the coast, accompanied by earthquakes and inroads of the sea. It is not impossible that the story of the bursting of the Black Sea through the Thracian Bosphorus into the Grecian Archipelago, which accompanied and, as some say, caused the Samothracian deluge, may have reference to a wave, or succession of waves, raised in the Euxine by the same convulsion.—LYELL *Principles of Geology*, bk. ii, ch. 22, p. 356. (A., 1854.)

3282. SUBSIDENCE OF LAND IN EARTHQUAKE—*Sudden Death in Fissures of the Earth.*—In the year 1692 the island of Jamaica was visited by a violent earthquake; the ground swelled and heaved like a rolling sea, and was traversed by numerous cracks, two or three hundred of which were often seen at a time, opening and then closing rapidly again. Many people were swallowed up in these rents; some the earth caught by the middle and squeezed to death; the heads of others only appeared above ground; and some were first engulfed and then cast up again with great quantities of water. Such was the devastation that even in Port Royal, then the capital, where more houses are said to have been left standing than in the whole island besides, three-quarters of the buildings, together with the ground they stood on, sank down, with their inhabitants, entirely under water. . . . The large storehouses on the harbor side subsided, so as to be twenty-four, thirty-six, and forty-eight feet under water, yet many of them appear to have remained standing, for it is stated that after the earthquake the mastheads of several ships wrecked in the harbor, together with the chimney-tops of houses, were just seen projecting above the waves. A tract of land round the town, about a thousand acres in extent, sank down in less than one minute during the first shock, and the sea immediately rolled in.—LYELL *Principles of Geology*, bk. ii, ch. 29, p. 504. (A., 1854.)

3283. SUBSIDENCE OF THE QUAY AT LISBON—*Crowds Engulfed under Sea and Land.*—Among other extraordinary events

related to have occurred at Lisbon during the catastrophe [the earthquake of 1755] was the subsidence of a new quay, built entirely of marble at an immense expense. A great concourse of people had collected there for safety, as a spot where they might be beyond the reach of falling ruins; but suddenly the quay sank down with all the people on it, and not one of the dead bodies ever floated to the surface. A great number of boats and small vessels anchored near it, all full of people, were swallowed up as in a whirlpool. No fragments of these wrecks ever rose again to the surface, and the water in the place where the quay had stood is stated, in many accounts, to be unfathomable; but Whitehurst says he ascertained it to be one hundred fathoms. — LYELL *Principles of Geology*, bk. ii, ch. 29, p. 495. (A., 1854.)

3284. SUBSISTENCE OF PRIMEVAL IMPULSE—*The Instinct of Habitation—Man Seeks at Once Shelter and Protection.*—There can be no doubt that the instinct to seek a sheltered nook, open only on one side, into which he may retire and be safe, is in man quite as specific as the instinct of birds to build a nest. It is not necessarily in the shape of a shelter from wet and cold that the need comes before him, but he feels less exposed and more at home when not altogether unenclosed than when lying all abroad. Of course the utilitarian origin of this ininstinct is obvious. But to stick to bare facts at present and not to trace origins, we must admit that this instinct now exists, and probably always has existed, since man was man. Habits of the most complicated kind are reared upon it. But even in the midst of these habits we see the blind instinct cropping out; as, for example, in the fact that we feign a shelter within a shelter by backing up beds in rooms with their heads against the wall, and never lying in them the other way—just as dogs prefer to get under or upon some piece of furniture to sleep, instead of lying in the middle of the room. The first habitations were caves and leafy grottoes, bettered by the hands; and we see children to-day, when playing in wild places, take the greatest delight in discovering and appropriating such retreats and "playing house" there.—JAMES *Psychology*, vol. ii, ch. 24, p. 426. (H. H. & Co., 1899.)

3285. SUBSTITUTES FOR NAILS, CLAMPS, AND SCREWS AMONG AMERICAN INDIANS—*Fire as a Tool.*—For nails and screws the Western mechanics employed "tree-nails" and all sorts of rope and twine and sinew-cord and rawhide string. They also made excellent glues and cements, from both vegetal and animal substances. For tightening a joint, they knew how to take advantage in the twisting of a rope. The power that can be put into a half-inch sinew-rope, by means of a trusty lever, is very great. The Eskimo bow is thus tightened. These mechanics were well versed in the use of fire as a tool, excavating and bending wood thereby, and among some tribes the bow was rendered more elastic in this manner.—MASON *Aboriginal American Mechanics (Memoirs of International Congress of Anthropology*, p. 74). (Sch. P. C.)

3286. SUBSTITUTES FOR VISE AND PINCERS — *Ingenuity of Adaptation.* — For grasping hot stones the American mechanics used tongs of wood, and in lieu of vises and strong pincers they resorted to the shrinking of vegetable fiber and of rawhide. They made a kind of clamp of two stout bits of wood, wrapped the two ends with spruce-root or rawhide, wet, and allowed it to dry. In this way the parts of a box could be held until they were sewed.—MASON *Aboriginal American Mechanics (Memoirs of International Congress of Anthropology*, p. 73). (Sch. P. C.)

3287. SUBSTITUTION OF FACULTIES GIVES ECONOMY OF POWER—*Aids to Memory—Dependence on One's Individuality.*—The same result may, in many cases, be achieved by different faculties. A man who can only remember facts should not trouble to try to learn by heart; there are very few cases in which the substance is not sufficient.

Those who can very easily learn by heart should use concise books, as their tendency will be to learn the words and miss the sense.

A man who cannot remember details should try to classify everything, and remember a general rule for the whole, as French words by the terminations, etc.

A man who can remember reasons better than anything else should try to find a reason for everything, simply as an aid to memory, using a bad reason instead of none at all.

The artist should make mental pictures of a subject, if not in a position to be able to draw them on paper. An artist's sketchbook often forms an admirable diary—that is, directly he looks at the drawings he has made the accompanying circumstances occur to his mind, and those which happened about that time, the names of the friends he was staying with, and the amusements they indulged in, all "coming back."—ELDRIDGE-GREEN *Memory and its Cultivation*, pt. ii, p. 275. (A., 1900.)

3288. SUCCESS AT OUTSET—*Habit of Achievement—Barbarians and Europeans.*—The need of securing success at the outset is imperative. Failure at first is apt to dampen the energy of all future attempts, whereas past experience of success nerves one to future vigor. Goethe says to a man who consulted him about an enterprise, but mistrusted his own powers: "Ach! you need only blow on your hands!" And the remark illustrates the effect on Goethe's spirits of his own habitually successful career. Professor Baumann, from whom I borrow the

anecdote, says that the collapse of barbarian nations when Europeans come among them is due to their despair of ever succeeding as the newcomers do in the larger tasks of life.—JAMES *Psychology*, vol. i, ch. 4, p. 124. (H. H. & Co., 1899.)

3289. SUCCESS TENDS TO BECOME A HABIT— It is matter of experience that . . . feelings of successful achievement do tend to fix in our memory whatever processes have led to them.—JAMES *Psychology*, vol. i, ch. 2, p. 71. (H. H. & Co., 1899.)

3290. SUFFERING OF ANIMALS LESS THAN CONJECTURED—There is, I think, good reason to believe that . . . the supposed "torments" and "miseries" of animals have little real existence, but are the reflection of the imagined sensations of cultivated men and women in similar circumstances, and that the amount of actual suffering caused by the struggle for existence among animals is altogether insignificant.—WALLACE *Darwinism*, ch. 2, p. 25. (Hum.)

3291. SUGAR SCIENTIFICALLY PRODUCED—*The Beet-sugar Industry.*—We see in the development of the beet-sugar industry in that country [Germany] an illustration of the immense industrial importance of pure and applied chemistry. On a soil not naturally fertile and exhausted by twenty centuries of agriculture, and in a climate not of the most hospitable kind, chemical science has developed a great industry which successfully competes with the warmth of climate and fertility of soil of the most favored tropical regions. Last year the German Empire produced nearly two million tons of sugar, a quantity as great as that produced by the whole world a little over a quarter of a century ago.—WILEY *Relations of Chemistry to Industrial Progress (Address at Purdue University, Lafayette, Ind., 1896*, p. 17).

3292. SUGGESTION A CAUSE OF ILLUSION—*Mental Impression Appears Objective.*—A suggested impression may appear so vividly before the mind as to completely overpower a real impression. Thus, I was once traveling by railroad to Battersea Park, and firmly believed that I had passed Chelsea, and that the next station was Battersea Park. When the train reached Chelsea I looked out of the carriage at the signboard, and saw Battersea Park there, as I expected, and got out of the train, but soon noticed that I had alighted at the wrong station; I felt perfectly convinced that I had seen Battersea Park on the signboard, and went back to look, of course only finding Chelsea. There was no mistake in the sense of one word being mistaken for another, for the words Battersea Park are not the least like the word Chelsea, and I looked directly at the signboard, and plainly saw Battersea Park. Such is the probable origin of a good many ghosts.—ELDRIDGE-GREEN *Memory and its Cultivation*, pt. i, ch. 7, p. 171. (A., 1900.)

3293. ——— ——— *Vision of Byron Seen after His Death by Sir Walter Scott.*—It is mentioned by Sir Walter Scott, in his "Demonology and Witchcraft," that having been engaged in reading with much interest, soon after the death of Lord Byron, an account of his habits and opinions, he was the subject of the following illusion:

Passing from his sitting-room into the entrance hall, fitted up with the skins of wild beasts, armor, etc., he saw right before him, and in a standing posture, the exact representation of his departed friend, whose recollection had been so strongly brought to his imagination. He stopped for a single moment so as to notice the wonderful accuracy with which fancy had impressed upon the bodily eye the peculiarities of dress and posture of the illustrious poet. Sensible, however, of the delusion, he felt no sentiment save that of wonder at the extraordinary accuracy of the resemblance, and stepped onwards towards the figure, which resolved itself, as he approached, into the various materials of which it was composed. These were merely a screen occupied by greatcoats, shawls, plaids, and such other articles as are usually found in a country entrance-hall. Sir Walter returned to the spot from which he had seen this product of what may be called imagination proper, and tried with all his might to recall it by the force of his will, but in vain.—CARPENTER *Mental Physiology*, ch. 5, p. 207. (A., 1900.)

3294. SUMMATION OF STIMULI—*Repeated Impulses Give Effect.*—We constantly use the summation of stimuli in our practical appeals. . . . If we are striving to remember a lost name or fact we think of as many "cues" as possible, so that by their joint action they may recall what no one of them can recall alone. The sight of a dead prey will often not stimulate a beast to pursuit, but if the sight of movement be added to that of form pursuit occurs. . . . "Dr. Allen Thomson hatched out some chickens on a carpet, where he kept them for several days. They showed no inclination to scrape, . . . but when Dr. Thomson sprinkled a little gravel on the carpet . . . the chickens immediately began their scraping movements." A strange person, and darkness, are both of them stimuli to fear and mistrust in dogs (and, for the matter of that, in men). Neither circumstance alone may awaken outward manifestations, but together, *i. e.*, when the strange man is met in the dark, the dog will be excited to violent defiance. Street-hawkers well know the efficacy of summation, for they arrange themselves in a line upon the sidewalk, and the passer often buys from the last one of them, through the effect of the reiterated solicitation, what

he refused to buy from the first in the row.—JAMES *Psychology*, vol. i, ch. 3, p. 84. (H. H. & Co., 1899.)

3295. SUN AS A FURNACE—*Pennsylvania's Coal Supply as Fuel—The Sun's Heat Constant through All Historic Time.*—How is this heat [of the sun] maintained? Not by the miracle of a perpetual self-sustained flame, we may be sure. But, then, by what fuel is such a fire fed? There can be no question of simple burning, like that of coal in the grate, for there is no source of supply adequate to the demand. The State of Pennsylvania, for instance, is underlaid by one of the richest coal-fields of the world, capable of supplying the consumption of the whole country at its present rate for more than a thousand years to come. If the source of the solar heat (whatever that is) were withdrawn, and we were enabled to carry this coal there, and shoot it into the solar furnace fast enough to keep up the known heat supply, so that the solar radiation would go on at just its actual rate, the time which this coal would last is easily calculable. It would not last days or hours, but the whole of these coal-beds would demonstrably be used up in rather less than one one-thousandth of a second! We find by a similar calculation that if the sun were itself one solid block of coal it would have burned out to the last cinder in less time than man has certainly been on the earth. But during historic times there has as surely been no noticeable diminution of the sun's heat, for the olive and the vine grow just as they did three thousand years ago, and the hypothesis of an actual burning becomes untenable.—LANGLEY *New Astronomy*, ch. 4, p. 97. (H. M. & Co., 1896.)

3296. SUN A STAR—*But a Point as Seen from Other Stars—Night Wraps the Universe Except around Each Star.*—Let us suppose ourselves, then. on the sun nearest to ours. From there our dazzling furnace is already lost like a little star, hardly recognizable among the constellations: earth, planets, comets sail in the invisible. We are in a new system. If we thus approach each star we find a sun, while all the other suns of space are reduced to the rank of stars. Strange reality!—the normal state of the universe is night. What we call day only exists for us because we are near a star.—FLAMMARION *Popular Astronomy*, bk. vi, ch. 1, p. 554. (A.)

3297. SUN, CHROMOSPHERE OF, AN OCEAN OF FIRE—*Metals in Vapor—Mountains of Glowing Hydrogen.*—Below the corona [of the sun], descending, we find the chromosphere, a sheet of fire from 6,000 to 9,000 miles in thickness, and which, here and there, is projected in immense masses which we might call flames, if this expression were not, in spite of its eloquence, very much below the reality. We call flame and fire that which burns; but the gases of the solar atmosphere are raised to such a degree of temperature that it is impossible for them to burn! Extremes meet. Hydrogen forms the upper part of the chromosphere; but as we descend we find vapors of magnesium, iron, and a great number of metals. The prominences are due to projections of hydrogen, shot up with velocities which exceed 240,000 meters (149 miles) per second. The eruption sometimes continues during several hours and even during several days, and these immense luminous clouds remain suspended without moving until they fall back in showers of fire on the solar surface. How can we conceive, how express, these tremendous operations of solar nature! If we call the chromosphere an ocean of fire, it should be added that it is an ocean hotter than the most intense fiery furnace, and also deeper than the Atlantic is wide. If we call these movements hurricanes, it should be remarked that our hurricanes blow with a force of 100 miles an hour, while on the sun they blow with a violence of 100 miles a second! Shall we compare them to volcanic eruptions? Vesuvius buried Pompeii and Herculaneum under its lava; a solar eruption rising in a few seconds to 60,000 miles in height would swallow up the entire earth in its rain of fire, and reduce to ashes all terrestrial life in less time than you take to read these lines. If our globe could fall into the sun it would melt and evaporate on arriving there like a flake of snow on red-hot iron.—FLAMMARION *Popular Astronomy*, bk. iii, ch. 5, p. 296. (A.)

3298. SUN LIFTS GLACIER TO MOUNTAIN—*Brings River Down.*—The sun, by the act of vaporization, lifts mechanically all the moisture of our air, which when it condenses falls in the form of rain, and when it freezes falls as snow. In this solid form it is piled upon the Alpine heights, and furnishes materials for glaciers. But the sun again interposes, liberates the solidified liquid, and permits it to roll by gravity to the sea. The mechanical force of every river in the world as it rolls towards the ocean is drawn from the heat of the sun. No streamlet glides to a lower level without having been first lifted to the elevation from which it springs by the power of the sun. The energy of winds is also due entirely to the same power.—TYNDALL *Fragments of Science*, vol. i, ch. 16, p. 378. (A., 1897.)

3299. SUN NOT STATIONARY—*Solar System Moves toward Constellation Hercules.*—The sun is not motionless in space. He moves on and draws with him the earth and the whole planetary system. We have detected his motion by that of the stars. When we travel on the railway, with the velocity of the new Pegasus of modern science, through countries diversified with fields, meadows, woods, hills, and villages, we see all the objects flying past us in a direction opposite to that of our motion. Well, by carefully watching the stars, we

observe an analogous fact in celestial objects. The stars appear animated with motions which draw them apparently towards a certain region of the sky—that which is behind us. On each side of us they seem to fly past, and the constellations which are in front of us appear to enlarge so as to open for us a passage. Calculation has shown that these perspective appearances are caused by the translation of the sun, the earth, and all the planets towards a region of the sky marked by the constellation Hercules. We travel towards that region with a velocity which it is difficult to determine exactly, but which appears to be from 400 to 500 millions of miles per annum. We leave the starry latitudes where Sirius sparkles, and we sail towards those where shine the stars of Lyra and of Hercules. The earth has never passed twice over the same course.—FLAMMARION *Popular Astronomy*, bk. i, ch. 5, p. 50. (A.)

3300. SUN SUPPOSED TO BE PURE AND QUENCHLESS FIRE—*Hence the Alchemists' Quest for an Ever-burning Lamp.*—To look across the space of over ninety million miles, and to try to learn from that distance the nature of the solar heat, and how it is kept up, seemed to the astronomers of the last century a hopeless task. The difficulty was avoided rather than met by the doctrine that the sun was pure fire, and shone because "it was its nature to." In the Middle Ages such an idea was universal; and along with it, and as a logical sequence of it, the belief was long prevalent that it was possible to make another such flame here, in the form of a lamp which should burn forever and radiate light endlessly without exhaustion. With the philosopher's stone, which was to transmute lead into gold, this perpetual lamp formed a prime object of research for the alchemist and student of magic.

We recall the use which Scott has made of the belief in this product of "gramarye" in the "Lay of the Last Minstrel," where it is sought to open the grave of the great wizard in Melrose Abbey. It is midnight when the stone which covers it is heaved away, and Michael's undying lamp, buried with him long ago, shines out from the open tomb and illuminates the darkness of the chancel.

I would you had been there to see
The light break forth so gloriously;
That lamp shall burn unquenchably
Until the eternal doom shall be,

says the poet. Now we are at liberty to enjoy the fiction as a fiction; but if we admit that the art which could make such a lamp would indeed be a black art, which did not work under Nature's laws, but against them, then we ought to see that, as the whole conception is derived from the early notion of a miraculous constitution of the sun, the idea of an eternal self-sustained sun is no more permitted to us than that of an eternal self-sustained lamp. We must look for the cause of the sun's heat in Nature's laws.—LANGLEY *New Astronomy*, ch. 4, p. 91. (H. M. & Co., 1896.)

3301. SUN THE SOURCE OF TERRESTRIAL ENERGY—*Decay the Recoiling of the Bent Spring.*—All terrestrial energy comes from the sun, and every manifestation of power on the earth can be traced directly back to his energizing and life-giving rays. The force with which oxygen tends to unite with the other elements may be regarded as a spring, which the sun's rays have the power to bend. In bending this spring they do a certain amount of work, and when, in the process of combustion, the spring flies back, the energy reappears. Moreover, the instability of all organized forms is but a phase of the same action, and the various processes of decay, with the accompanying phenomenon of death, are simply the recoiling of the same bent spring. Amid all these varied phenomena, the one element which reappears in all, and frequently wholly engrosses our attention, is energy.—COOKE *New Chemistry*, lect. 10, p. 235. (A., 1899.)

3302. ——— ——— *Delicacy as Well as Power Due to Central Orb.*—We have . . . been led to recognize the sun as the ultimate material source of all the energy which we possess, and we must now regard him as the source likewise of all our delicacy of construction. It requires the energy of his high-temperature rays so to wield and manipulate the powerful forces of chemical affinity, so to balance these various forces against each other, as to produce in the vegetable something which will afford our frames not only energy, but also delicacy of construction. Low-temperature heat would be utterly unable to accomplish this; it consists of ethereal vibrations which are not sufficiently rapid, and of waves that are not sufficiently short, for the purpose of shaking asunder the constituents of compound molecules. It thus appears that animals are, in more ways than one, pensioners upon the sun's bounty.—STEWART *Conservation of Energy*, ch. 6, p. 413. (Hum., 1880.)

3303. ——— ——— *Deprivation of Sunlight Would Speedily Destroy All Activity on Earth.*—When we come to inquire for the source of the energy which lifts the water from the sea to the mountain-top, which decomposes the carbonic acid of the atmosphere and plant-foods of the soil, and builds up the hydrocarbons and other fuels of animal and vegetable tissue, we find it always mainly in the solar rays. I say mainly, because, of course, the light and heat of the stars, the impact of meteors, and the probable slow contraction of the earth, are all real sources of energy, and contribute their quota. But, as compared with the energy derived from the sun, their total amount is probably something like the ratio of starlight to sunlight; so

small that it is quite clear . . . that a month's deprivation of the solar rays would involve the utter destruction of all activity upon the earth.—YOUNG *The Sun*, int., p. 4. (A., 1898.)

3304. ——— ——— *Our Varied Powers Derived from Its Heat—All Life Due to Solar Influence.*—Everything which moves, circulates, and lives on our planet is the child of the sun. . . . The most nutritious foods come from the sun. The wood which warms us in winter is, again, the sun in fragments; every cubic inch, every pound of wood, is formed by the power of the sun. The mill which turns under the impulse of wind or water revolves only by the sun. And in the black night, under the rain or snow, the blind and noisy train which darts like a flying serpent through the fields, rushes along above the valleys, is swallowed up under the mountains, goes hissing past the stations, of which the pale eyes strike silently through the mist—in the midst of night and cold this modern animal, produced by human industry, is still a child of the sun; the coal from the earth which feeds its stomach is solar work stored up during millions of years in the geological strata of the globe. As it is certain that the force which sets the watch in motion is derived from the hand which has wound it, so it is certain that all terrestrial power proceeds from the sun. It is its heat which maintains the three states of bodies—solid, liquid, and gaseous; the last two would vanish, there would be nothing but solids, water, and air itself would be in massive blocks, if the solar heat did not maintain them in the fluid state. It is the sun which blows in the air, which flows in the water, which moans in the tempest, which sings in the unwearied throat of the nightingale. It attaches to the sides of the mountains the sources of the rivers and glaciers, and consequently the cataracts and the avalanches are precipitated with an energy which they draw directly from him. Thunder and lightning are in their turn a manifestation of his power. Every fire which burns and every flame which shines has received its life from the sun. And when two armies are hurled together with a crash, each charge of cavalry, each shock between two army corps, is nothing else but the misuse of mechanical force from the same star. The sun comes to us in the form of heat, he leaves us in the form of heat, but between his arrival and his departure he has given birth to the varied powers of our globe.—FLAMMARION *Popular Astronomy*, bk. iii, ch. 3, p. 245. (A.)

3305. SUN THE SOURCE OF TERRESTRIAL LIFE—*Three Necessary Elements Supplied—Light, Heat, and Actinism.*—Our sun sends forth rays which supply three very different requirements of living creatures, animal and vegetable, peopling out earth. Without light, we should all before long perish miserably; and the sun's rays supply us with light. Without heat, we should be even more quickly destroyed; and the sun's rays provide ample supplies of heat. But besides light and heat, we require, directly and indirectly, that chemical action of the solar rays which has been called actinism. Without this action the air we breathe would be loaded before long with pestilential vapors, which would destroy the lives of men and animals; plants would wither, and presently die; the whole earth, in fact, would soon be the abode of death, as surely, tho perhaps not so quickly, as tho the sun had ceased to supply either light or heat. Now at present these three forms of energy are exerted in certain proportions admirably suited to our requirements. Dividing the solar rays according to the position they occupy with reference to the spectrum, we have from the red rays, and from dark rays beyond the red, the chief supply of heat; from the whole visible spectrum, but chiefly from the yellow portion, comes the supply of light; and lastly, the violet rays and the dark rays beyond the violet afford the chief supply of actinism.—PROCTOR *Our Place among Infinities*, p. 212. (L. G. & Co., 1897.)

3306. SUN'S CORONA YET A MYSTERY—*Limited Opportunities for Observation—Three-quarters of an Hour in Thirty Years.*—Our knowledge of the corona remains very incomplete, and if the most learned in such matters were asked what it was, he could probably answer truthfully, "I don't know."

This will not be wondered at when it is considered that as total eclipses come about every other year, and continue. one with another, hardly three minutes, an astronomer who should devote thirty years exclusively to the subject, never missing an eclipse in whatever quarter of the globe it occurred, would in that time have secured, in all, something like three-quarters of an hour for observation. Accordingly, what we know best about the corona is how it looks, what it is being still largely conjecture.—LANGLEY *New Astronomy*, ch. 2, p. 59. (H. M. & Co., 1896.)

3307. SUN'S HEAT PRODUCED BY CONCENTRATION—*Probable Continued Duration of Solar Light and Heat.*—For how many ages has the sun himself shone? On the hypothesis that the nebulous matter was originally of extreme tenuity has been calculated the quantity of heat which must have been produced by the fall of all those molecules towards the center to the condensation of which was due the birth of the solar system. Supposing the specific heat of the condensing mass was that of water, the heat of the condensation would be sufficient to produce an elevation of temperature of 28 millions of degrees centigrade (Helmholtz and Tyndall). It has been known for some time past that heat is but a mode of motion; it is an infinitesimal vi-

bratory motion of the atoms. We can now convert at will all motion into heat, and all heat into motion. The motion of condensation has sufficed, and more than sufficed, to produce the present temperature of the sun and the original temperature of all the planets. If that brilliant star continues to condense, as is probable, a condensation which would shorten its diameter by $\frac{1}{10000}$ of its present length would produce a quantity of heat sufficient to cover the loss by emission during two thousand years. At the present rate of emission the solar heat produced by the earlier condensation of its mass would still last for 20 millions of years.—FLAMMARION *Popular Astronomy*, bk. i, ch. 7, p. 75. (A.)

3308. SUN'S SURFACE PHOTOGRAPHED—*Under the Camera—Photograph Secures Details Invisible to the Eye—Openings in an Atmosphere of Vaporized Metal—Reality Surpassing Wildest Dream.*—The photograph has transported us already so near the sun's surface that we have seen details there invisible to the naked eye. . . . What we have called "spots" are indeed regions whose actual vastness surpasses the vague immensity of a dream, and it will not cause surprise that in them is a temperature which also surpasses greatly that of the hottest furnace. . . . The whole surface is composed largely of metals turned into vapor in this heat, and . . . if we could indeed drop our great globe itself upon the sun it would be dissipated as a snowflake.—LANGLEY *New Astronomy*, ch. 1, p. 19. (H. M. & Co., 1896.)

3309. "SUNNY FRANCE" BURIED UNDER ICE—*The Glacial Epoch.*—At the time of the maximum extension of the ice-sheet almost the whole of the Swiss lowland was buried, and the ice welled up against the flanks of the Jura to a height of 3,000 feet above the Lake of Neuchâtel, whence it extended northward to the neighborhood of Soleure. Along the present course of the Rhone it sent out a huge lobe far beyond the frontier of Switzerland, for erratics [scattered boulders] and other glacial deposits have been traced to within a few miles of Lyons. It is estimated that altogether the ancient glacier of the Rhone was not less than 270 miles in length.—BONNEY *Ice-work, Present and Past*, pt. i, ch. 1, p. 35. (A., 1896.)

3310. SUNSET MADE BEAUTIFUL BY DUST—Owing to the constant presence of air currents, arranging both the dust and vapor [in the atmosphere] in strata of varying extent and density, and of high or low clouds, which both absorb and reflect the light in varying degrees, we see produced all those wondrous combinations of tints and those gorgeous ever-changing colors which are a constant source of admiration and delight to all who have the advantage of an uninterrupted view to the west, and who are accustomed to watch for these not unfrequent exhibitions of Nature's kaleidoscopic color-painting. With every change in the altitude of the sun the display changes its character, and most of all when it has sunk below the horizon, and, owing to the more favorable angles, a larger quantity of the colored light is reflected toward us. Especially when there is a certain amount of cloud is this the case. These, so long as the sun was above the horizon, intercepted much of the light and color; but when the great luminary has passed away from our direct vision his light shines more directly on the under sides of all the clouds and air strata of different densities; a new and more brilliant light flushes the western sky, and a display of gorgeous, ever-changing tints occurs which are at once the delight of the beholder and the despair of the artist. And all this unsurpassable glory we owe to dust!—WALLACE *The Wonderful Century*, ch. 9, p. 75. (D. M. & Co., 1899.)

3311. SUNSET MERGING INTO SUNRISE—*Effect of Atmospheric Refraction—The Midnight Sun at Tornea.*—It is not necessary to go to the polar circle in order to see the sun not setting and grazing the horizon at midnight. At the sixty-sixth degree of latitude in Sweden and Finland we can enjoy this spectacle, so strange to us—the midnight sun. It has even become the fashion in recent years to make a voyage to Tornea, a little town on the frontiers of Russia and Sweden, on the Gulf of Bothnia, and to be present on June 21 on Mount Avasaxa, only 227 meters high, when the sun does not set at the summer solstice.—FLAMMARION *Popular Astronomy*, bk. i, ch. 2, p. 30. (A.)

3312. SUNSHINE, DECREASE OF, IN ENGLAND—*The Vine Once Freely Grown—The Dust from Manufactories Changing a Nation's Climate.*—Now, there is much evidence to show that there has been a considerable increase in the amount of cloud, and consequent decrease in the amount of sunshine, in all parts of our country. It is an undoubted fact that in the Middle Ages England was a wine-producing country, and this implies more sunshine than we have now. . . . Some years back one of our gardening periodicals obtained from gardeners of forty or fifty years' experience a body of facts clearly indicating a comparatively recent change of climate. It was stated that in many parts of the country, especially in the north, fruits were formerly grown successfully and of good quality in gardens where they cannot be grown now. . . . But an increase of cloud, and consequent diminution of sunshine, would produce just such a result; and this increase is almost certain to have occurred, owing to the enormously increased amount of dust thrown into the atmosphere as our country has become more densely populated, and es-

pecially owing to the vast increase of our smoke-producing manufactories. . . . When this fact is thoroughly realized we shall surely put a stop to such a reckless and wholly unnecessary production of injurious smoke and dust.—WALLACE *The Wonderful Century*, ch. 9, p. 84. (D. M. & Co., 1899.)

3313. SUNSHINE, DURATION OF—*A Sunshine Autograph.*—For determining the duration of sunshine use is made of a simple apparatus called the sunshine autograph. Its common form is that of a ball of clear glass set up free, which collects the sun's rays like a burning glass, burning an index in a paper strip fastened behind the globe if the sunshine is bright enough. Since the paper strip is divided into hours it can be easily read when and how long the sun has been shining upon the apparatus. If the duration of sunshine thus obtained is compared with the length of day, the actual with the possible number of sunny hours, we obtain a number that in fact not only announces during what fraction of the hours of the day the sun was uncovered, but which harmonizes very well with the estimates of the entire cloud-covering. Many an important deduction concerning the thriving as well as the possibility of the improvement of plants, grapes, fruits, beets, etc., for whose development sunshine is particularly important, can be thus derived.—BÖRNSTEN *Leitfaden der Wetterkunde, 1901*, p. 58. (Translated for *Scientific Side-Lights.)*

3314. SUN-SPOTS EASILY SEEN—*Overlooked by Minds Unprepared to Recognize Them.*—An object of this size [30,000 miles] upon the sun's surface can easily be seen without a telescope when the brightness is reduced either by clouds, or nearness to the horizon, or by the use of a shade-glass. At the transit of Venus, in 1882, every one saw the planet readily without telescopic aid. Her apparent diameter was about 67″ at the time, which is equivalent to about 31,000 miles on the solar surface. Probably a very keen eye would detect a spot measuring not more than 23,000 or 24,000 miles.

Hardly a year passes, at times when spots are numerous, without furnishing several as large as this, so that it is rather surprising than otherwise that we have not a greater number of sun-spot records in the pretelescopic centuries. The explanation probably lies in two things: the sun is too bright to be often or easily looked at, and when spots were seen they would be likely to be taken for optical illusions rather than realities.—YOUNG *The Sun*, ch. 4, p. 27. (A., 1898.)

3315. SUN-SPOTS, SUPPOSED APERTURES IN SOLAR CLOUDS—*Herschel's Theory.*—Sir William Herschel, reasoning from terrestrial analogies, was led to look on the spot cavities as apertures through a double layer of clouds. He argued that were the solar photosphere of any other nature, it would be past comprehension that vast openings should form in it, to remain open for months before they close up again. . . . And because the solar spots present two distinct varieties of light, the faint penumbra and the dark umbra or nucleus, Herschel saw the necessity of assuming that there are two beds of clouds, the outer self-luminous and constituting the true solar photosphere, the inner reflecting the light received from the outer layer, and so shielding the real surface of the sun from the intense light and heat which it would otherwise receive.—PROCTOR *Other Worlds than Ours*, ch. 2, p. 36. (Burt.)

3316. SUPERFICIALITY OF MATERIALISM—*Science Does Not Include Philosophy—Eternal Problems behind Phenomena.*—Nothing is more common than to find men who may be trusted thoroughly on the facts of their own science, who cannot be trusted for a moment on the place which those facts assume in the general system of truth. Philosophy must include science; but science does not necessarily include philosophy. There are, and there always have been, some special misconceptions connected with the prosecution of physical research. It is, however, on the surface of things, rather than below it, that the suggestions of materialism lie thickest to the eye. They abound among the commonest facts which obtrude themselves on our attention in Nature and in human life. When the bursting of some small duct of blood upon the brain is seen to destroy in a moment the mind of man, and to break down all the powers of his intellect and his will, we are in presence of a fact whose significance cannot be increased by a million of other facts analogous in kind. Yet on every fresh discovery of a few more such facts there is generally some fresh outbreak of old delusions respecting the forms and the laws of matter as the supreme realities of the world. But when the new facts have been looked at a little longer it is always seen that they take their place with others which have been long familiar, and the eternal problems which lie behind all natural phenomena are seen to be unaffected and unchanged. Like the most distant of the fixed stars, they have no parallax.—ARGYLL *Reign of Law*, ch. 2, p. 68. (Burt.)

3317. SUPERNATURAL, THE, VS. THE SUPERHUMAN—*True and False Views of Law—Classification Is Not Explanation.*—Theological and philosophical writers frequently use the supernatural as synonymous with the superhuman. But of course this is not the sense in which any one can have any difficulty in believing in it. The powers and works of Nature are all superhuman—more than man can account for in their origin—more than he can resist in their energy—more than he can understand

in their effects. This, then, cannot be the sense in which so many minds find it hard to accept the supernatural; nor can it be the sense in which others cling to it as of the very essence of their religious faith. What, then, is that other sense in which the difficulty arises? Perhaps we shall best find it by seeking the idea which is competing with it, and by which it has been displaced. It is the natural which has been casting out the supernatural—the idea of natural law—the universal reign of a fixed order of things. This idea is a product of that immense development of the physical sciences which is characteristic of our time. We cannot read a periodical, or go into a lecture-room, without hearing it expressed. Sometimes, but rarely, it is stated with accuracy, and with due recognition of the limits within which law can be said to comprehend the phenomena of the world. But generally it is expressed in language vague and hollow, covering inaccurate conceptions, and confounding under common forms of expression ideas which are essentially distinct. The mere ticketing and orderly assortment of external facts is constantly spoken of as if it were in the nature of explanation, and as if no higher truth in respect to natural phenomena were to be attained or desired.—ARGYLL *Reign of Law*, ch. 1, p. 2. (Burt.)

3318. SUPERSTITION ACCOUNTING FOR THE FROZEN MAMMOTH—The inhabitants of Siberia seem to be familiar with this animal, which they designate by the name of mammoth, while naturalists call it *Elephas primigenius.* The circumstance that they abound in the frozen drift of the great northern plain of Asia, and are occasionally exposed in consequence of the wearing of the large rivers traversing Siberia, has led to the superstition among the Tongouses that the mammoths live underground, and die whenever, on coming to the surface, the sunlight falls upon them.—AGASSIZ *Geological Sketches*, ser. i, ch. 7, p. 183. (H. M. & Co., 1896.)

3319. SUPERSTITION ASCRIBES INUNDATIONS TO ARRIVAL OF SHIPS—In Kotzebue's "Voyage" there are accounts of islands, both in the Caroline and Marshall Archipelagoes, which have been partly washed away during hurricanes; and Kadu, the native who was on board one of the Russian vessels, said "he saw the sea at Radack rise to the feet of the coconut-trees; but it was conjured in time. . . . According to a tradition which was communicated to Captain Fitz Roy, it is believed in the Low Archipelago that the arrival of the first ship caused a great inundation which destroyed many lives.—DARWIN *Coral Reefs*, ch. 5, p. 129. (A., 1900.)

3320. SUPERSTITION AS TO AURORA BOREALIS—*Armies Seen Battling in the Sky.*—Pliny, the naturalist ("Naturalis Historia," ii, 26, 27, 33, and 57), says: "There are seen in the heaven (and nothing is more terrible for trembling mortals) blood-colored flames which afterwards fall upon the earth, as it happened in the third year of the hundred and seventh Olympiad, when King Philip ruled over Greece. . . . It is said that at the time of the wars of the Cimbri, and also often before and since, the clashing of arms and the sound of trumpets were heard in the sky. But in the third consulate of Marius the dwellers in Ameria and Tuderta saw in the heavens two armies rushing one against the other from the east and from the west; that of the west was defeated. The heaven itself caught fire: this is no extraordinary thing, and it has often been seen when the clouds are exposed to great heat."

In this quotation from Pliny we find for the first time the trace of that popular superstition which obtained almost down to our own day, and which attributed the great auroras to armies combating in the sky.—ANGOT *Aurora Borealis*, ch. 1, p. 3. (A., 1897.)

3321. SUPERSTITION AS TO PORTRAITS—*Life Shown in Picture Thought to Be Taken Away from Original.*—The redskins are not altogether deficient in art, being able to make rude carvings, and to trace equally rude drawings on their wigwams, robes, etc.; but about portraits they have some curious ideas. They think that an artist acquires some mysterious power over any one whose likeness he may have taken; and on one occasion, when annoyed by some Indians, Mr. Kane got rid of them at once by threatening to draw any one who remained. Not one ventured to do so. If the likeness is good, so much the worse; it is, they fancy, half alive—at the expense of the sitter. So much life, they argue, could only be put in the picture by taking it away from the original. Again they fancy that if the picture were injured, by some mysterious connection the original would suffer also.—AVEBURY *Prehistoric Times*, ch. 14, p. 504. (A., 1900.)

3322. SUPERSTITION CLOUDS TRIUMPH OF SCIENTIST—*A Trial for Witchcraft.*—The figurative and poetical myths of the Pythagorean and Platonic pictures of the universe, changeable as the fancy from which they emanated, may still be traced partially reflected in Kepler; but while they warmed and cheered his often saddened spirit, they never turned him aside from his earnest course, the goal of which he reached in the memorable night of the 15th of May, 1618, twelve years before his death. . . . "On the 8th of March, 1618, it occurred to Kepler, after many unsuccessful attempts, to compare the squares of the times of revolution of the planets with the cubes of the mean distances; but he made an error in his calculations, and rejected this idea. On the 15th of May, 1618, he again reverted to it, and calculated correctly. The third law

of Kepler was now discovered." This discovery and those related to it coincide with the unhappy period when this great man, who had been exposed from early childhood to the hardest blows of fate, was striving to save from the torture and the stake his mother, who, at the age of seventy years, in a trial for witchcraft, which lasted six years, had been accused of poison-mixing, inability of shedding tears, and of sorcery. The suspicion was increased from the circumstance that her own son, the wicked Christopher Kepler, a worker in tin, was her accuser, and that she had been brought up by an aunt who was burned at Weil as a witch.—HUMBOLDT *Cosmos*, vol. ii, pt. ii, p. 314. (H., 1897.)

3323. SUPERSTITION DEFEATING KINDNESS—*The Emperor of China Buries a Burning-glass.*—It is said that the Emperor of China, when he got his lens [a three-foot burning-glass, made at great expense, and sent by the English government as a present to the Chinese monarch], was much alarmed by it, as being possibly sent him by the English with some covert design for his injury. By way of a test, a smith was ordered to strike it with his hammer; but the hammer rebounded from the solid glass, and this was taken to be conclusive evidence of magic in the thing, which was immediately buried, and probably is still reposing under the soil of the Celestial Flowery Kingdom. —LANGLEY *New Astronomy*, ch. 4, p. 103. (H. M. & Co., 1896.)

3324. SUPERSTITION, EFFECTS OF—*Historic Eclipses Have Affected Believers in Their Malign Influence.*—History relates a crowd of memorable acts on which eclipses have had the greatest influence. Alexander, before the battle of Arbela, expected to see his army routed by the appearance of a phenomenon of this kind. The death of the Athenian general, Nicias, and the ruin of his army in Sicily, with which the decline of the Athenians commenced, had for their cause an eclipse of the moon. We know how Christopher Columbus, with his little army, threatened with death by famine at Jamaica, found means of procuring provisions from the natives by depriving them in the evening of the light of the moon. The eclipse had scarcely commenced when they supplied him with food. This was the eclipse of March 1, 1504, observed in Europe at Ulm by Stoffer, and at Nuremberg by Bernard Walter, and which happened at Jamaica at 6 o'clock in the evening. We need not relate other facts of this nature, in which history abounds, and which are known to every one.—FLAMMARION *Popular Astronomy*, bk. ii, ch. 9, p. 181. (A.)

3325. SUPERSTITION FOUNDS ON NATURAL PHENOMENON—*The "Fairy Rings."*—Several low forms of plant life, such as *Marasmius oreades, Spathularia flavida*, and some of the puffballs, start in isolated spots in the grass of a lawn or pasture, and spread each year from a few inches to a foot or more in every direction, usually in the form of a circle; at the end of fifteen years some of these circles acquire a diameter of fifteen to twenty feet or more. These are known as fairy rings. Before science dispelled the illusion they were believed to have been the work of witches, elves, or evil spirits, from which arose the name.—BEAL *Seed Dispersal*, ch. 2, p. 4. (G. & Co., 1898.)

3326. SUPERSTITION IN AVOIDING SUPERSTITION—*Danger of Undue Recoil.*—Superstition, without a veil, is a deformed thing; for as it addeth deformity to an ape to be so like a man, so the similitude of superstition to religion makes it the more deformed; and as wholesome meat corrupteth to little worms, so good forms and orders corrupt into a number of petty observances. There is a superstition in avoiding superstition, when men think to do best if they go furthest from the superstition formerly received; therefore care would be had that (as it fareth in ill purgings) the good be not taken away with the bad, which commonly is done.—BACON *Essays*, essay 17, *Of Superstition*, p. 63. (W. L. A.)

3327. SUPERSTITION, INDICATIONS OF, IN LOWER ANIMALS—*Fear as a Result of Intellectual Confusion—Dog Terrified by Mystery.*—It produces a strange emotional "curdle" in our blood to see a process with which we are familiar deliberately taking an unwonted course. Any one's heart would stop beating if he perceived his chair sliding unassisted across the floor. The lower animals appear to be sensitive to the mysteriously exceptional as well as ourselves. My friend, Professor W. K. Brooks, of the Johns Hopkins University, told me of his large and noble dog being frightened into a sort of epileptic fit by a bone being drawn across the floor by a thread which the dog did not see. Darwin and Romanes have given similar experiences.—JAMES *Psychology*, vol. ii, ch. 24, p. 419. (H. H. & Co., 1899.)

3328. SUPERSTITION, ITS EXPLANATION OF SCIENTIFIC FACT—At the place where we slept [11,000 feet up in the Andes] water necessarily boiled, from the diminished pressure of the atmosphere, at a lower temperature than it does in a less lofty country, the case being the converse of that of a Papin's digester. Hence the potatoes, after remaining for some hours in the boiling water, were nearly as hard as ever. The pot was left on the fire all night, and next morning it was boiled again, but yet the potatoes were not cooked. I found out this by overhearing my two companions [Chileans] discussing the cause; they had come to the simple conclusion "that the cursed pot (which was a new one) did not choose to boil potatoes."—DARWIN *Naturalist's Voyage around the World*, ch. 15, p. 323. (A., 1898.)

3329. SUPERSTITION PREVENTING SCIENTIFIC STUDY—*Science Thought to Tempt to Witchcraft.*—In . . . ages so inimical to intellectual culture, when Christianity was diffused among the Germanic and Celtic nations, who had previously been devoted to the worship of Nature, and had honored under rough symbols its preserving and destroying powers, intimate intercourse with Nature, and a study of its phenomena, were gradually considered suspicious incentives to witchcraft. This communion with Nature was regarded in the same light as Tertullian, Clement of Alexandria, and almost all the older fathers of the church had considered the pursuit of the plastic arts. In the twelfth and thirteenth centuries the Councils of Tours (1163) and of Paris (1209) interdicted to monks the sinful reading of works on physics. Albertus Magnus and Roger Bacon were the first who boldly rent asunder these fetters of the intellect, and thus, as it were, absolved Nature, and restored her to her ancient rights.—HUMBOLDT *Cosmos*, vol. ii, pt. i, p. 43. (H., 1897.)

3330. SUPPORT FOR TREE-CLIMBER—*Perfect Grasp of Branches—The Monkey's Prehensile Tail.*—In the spider monkeys, the woolly monkeys, and the howling monkeys, the undersurface of the terminal portion of the tail is naked, so that it can be very closely applied to any surface with which it is in contact. The tail itself is a very powerful organ, and is capable of curling its own end so firmly round an object that the animal's whole body can thus be safely suspended. A tail of this kind is called a "prehensile tail." Not every American monkey has it, but no monkey which is not American possesses anything of the kind. Its possession must greatly add to the security and ease of locomotion of any forest-dwelling beast.—MIVART *Types of Animal Life*, ch. 1, p. 5. (L. B. & Co., 1893.)

3331. SUPREMACY COVETED IN A MAN'S CHOSEN FIELD—*Shame of Surpassing All but One.*—I, who for the time have staked my all on being a psychologist, am mortified if others know much more psychology than I. But I am contented to wallow in the grossest ignorance of Greek. My deficiencies there give me no sense of personal humiliation at all. Had I "pretensions" to be a linguist it would have been just the reverse. So we have the paradox of a man shamed to death because he is only the second pugilist or the second oarsman in the world. That he is able to beat the whole population of the globe minus one is nothing; he has "pitted" himself to beat that one, and as long as he doesn't do that nothing else counts. He is to his own regard as if he were not, indeed he is not.—JAMES *Psychology*, vol. i, ch. 10, p. 310. (H. H. & Co., 1899.)

3332. SUPREMACY OF MIND—*Newton—Scientific Fame Surpassing That of Warriors and Kings.*—There are, perhaps, no two sets of human beings who comprehend less the movements, and enter less into the cares and concerns, of each other, than the wide and busy public on the one hand, and on the other those men of close and studious retirement whom the world never hears of, save when, from their thoughtful solitude, there issues forth some splendid discovery to set the world on a gaze of admiration. Then will the brilliancy of a superior genius draw every eye towards it, and the homage paid to intellectual superiority will place its idol on a loftier eminence than all wealth or than all titles can bestow, and the name of the successful philosopher will circulate, in his own age, over the whole extent of civilized society, and be borne down to posterity in the characters of ever-enduring remembrance; and thus it is that when we look back on the days of Newton we annex a kind of mysterious greatness to him, who, by the pure force of his understanding, rose to such a gigantic elevation above the level of ordinary men, and the kings and warriors of other days sink into insignificance around him, . . . and, while all the vulgar grandeur of other days is now moldering in forgetfulness, the achievements of our great astronomer are still fresh in the veneration of his countrymen, and they carry him forward on the stream of time, with a reputation ever gathering, and the triumphs of a distinction that will never die.—CHALMERS *Astronomical Discourses*, p. 44. (R. Ct., 1848.)

3333. SURPRISE OF AERONAUT—*Falling Stone Follows Balloon—Communication of Motion.*—When we drop a stone from the top of the mast of a ship in motion it falls exactly at the foot of the mast, just as if the ship were at rest. The motion of the vessel is communicated to the mast, to the stone, and to everything on the floating abode; there is nothing but the resistance of the liquid plain cleft by the ship which permits the passengers to perceive the motion. It is the same on the railway and in a balloon. But as the earth does not encounter any strange obstacle, there is absolutely nothing in Nature which can by its resistance, by its motion, or by its shock, enable us to perceive the motion. This motion is common to all terrestrial bodies; if they are raised in the air, they have received beforehand the motion of our globe, its direction and its velocity; and even when they are at the highest point of the atmosphere they continue to move as the earth does.

We verify the same law in a balloon. I remember myself one day passing over the town of Orleans. I had taken care to write a despatch addressed to the leading journal of that town, and I had expected when we arrived above a promenade to let it fall,

by affixing a stone for a counterpoise. What was my surprise to see this stone, while descending, suspended beneath the balloon as if it had slipped the length of a cord. The balloon sails rather fast. Instead of falling on the spot I had chosen, or even in the town, the despatch, following a diagonal, fell into the Loire. I had not reflected on one of the oldest questions of my bachelor's degree, the independence of simultaneous motions. Very fortunately the balloon, having crossed the Loire, had towards evening descended sufficiently near the earth to allow us to hail an inhabitant of the town, who was following the Orleans road, on his way home, seated in a cabriolet, which advanced at a slow pace. It was nightfall, and the Angelus was wafted from the village bells. Much surprised was this traveler on hearing himself hailed from the height of heaven. He seemed at first to believe neither his ears nor his eyes. But the horse was promptly stopped, and we had sufficient time to announce our passing, which next morning was published in the newspapers.—FLAMMARION *Popular Astronomy*, p. 58. (A.)

3334. SURPRISE OF A GREAT DISCOVERY—*Newton Discovers the Spectrum—Light Composite—Its Apparent Simplicity Delusive.*—In the rainbow a new phenomenon was introduced—the phenomenon of color. And here we arrive at one of those points in the history of science when great men's labors so intermingle that it is difficult to assign to each worker his precise meed of honor. Descartes was at the threshold of the discovery of the composition of solar light; but for Newton was reserved the enunciation of the true law. He went to work in this way: Through the closed window-shutter of a room he pierced an orifice and allowed a thin sunbeam to pass through it. The beam stamped a round white image of the sun on the opposite wall of the room. In the path of this beam Newton placed a prism, expecting to see the beam refracted, but also expecting to see the image of the sun, after refraction, still round. To his astonishment, it was drawn out to an image with a length five times its breadth. It was, moreover, no longer white, but divided into bands of different colors. Newton saw immediately that solar light was composite, not simple. His elongated image revealed to him the fact that some constituents of the light were more deflected by the prism than others, and he concluded, therefore, that white solar light was a mixture of lights of different colors, of different degrees of refrangibility.—TYNDALL *Lectures on Light*, lect. 1, p. 26. (A., 1898.)

3335. SURRENDER OF PRETENSIONS A RELIEF FROM STRAIN—Yonder puny fellow, . . . , whom every one can beat, suffers no chagrin about it, for he has long ago abandoned the attempt to "carry that line," as the merchants say, of self at all. With no attempt there can be no failure; with no failure no humiliation. So our self-feeling in this world depends entirely on what we back ourselves to be and do. It is determined by the ratio of our actualities to our supposed potentialities, a fraction of which our pretensions are the denominator and the numerator our success: thus

$$\text{Self-esteem} = \frac{\text{Success}}{\text{Pretensions}}.$$

Such a fraction may be increased as well by diminishing the denominator as by increasing the numerator. To give up pretensions is as blessed a relief as to get them gratified; and where disappointment is incessant and the struggle unending, this is what men will always do. The history of evangelical theology, with its conviction of sin, its self-despair, and its abandonment of salvation by works, is the deepest of possible examples, but we meet others in every walk of life.—JAMES *Psychology*, vol. i, ch. 10, p. 310. (H. H. & Co., 1899.)

3336. ——— ——— *Illusions Abandoned—Burdens Dropped.*—There is the strangest lightness about the heart when one's nothingness in a particular line is once accepted in good faith. All is not bitterness in the lot of the lover sent away by the final inexorable "No." Many Bostonians, *crede experto* (and inhabitants of other cities, too, I fear) would be happier women and men to-day if they could once for all abandon the notion of keeping up a Musical Self, and without shame let people hear them call a symphony a nuisance. How pleasant is the day when we give up striving to be young—or slender! Thank God! we say, those illusions are gone. Everything added to the Self is a burden as well as a pride. A certain man who lost every penny during our civil war went and actually rolled in the dust, saying he had not felt so free and happy since he was born.—JAMES *Psychology*, vol. i, ch. 10, p. 311. (H. H. & Co., 1899.)

3337. SURVIVAL NOT BY CHANCE—*Some Quality of the Organism Determines.—Variations Universal.*—Why do some live rather than others? If all the individuals of each species were exactly alike in every respect we could only say it is a matter of chance. But they are not alike. We find that they vary in many different ways. Some are stronger, some swifter, some hardier in constitution, some more cunning. An obscure color may render concealment more easy for some, keener sight may enable others to discover prey or escape from an enemy better than their fellows. Among plants the smallest differences may be useful or the reverse. The earliest and strongest shoots may escape the slug; their greater vigor may enable them to flower and seed earlier in wet autumn; plants best armed with spines or hairs may escape being devoured; those whose flowers are most conspicuous may be soonest fertilized by in-

sects. We cannot doubt that, on the whole, any beneficial variations will give the possessors of it a greater probability of living through the tremendous ordeal they have to undergo. There may be something left to chance, but on the whole the fittest will survive.—WALLACE *Darwinism*, ch. 1, p. 7. (Hum.)

3338. SURVIVAL OF THE FITTEST—*Fitness Is Fittedness—The Texas Bull and the Mosquito—The Prize-fighter and the Cripple—Social Compassion Makes a New Fitness for the Weak.*—The survival of the fittest, of course, does not mean the survival of the strongest. It means the survival of the adapted—the survival of the [one] most fitted to the circumstances which surround it. A fish survives in water when a leaking ironclad goes to the bottom, not because it is stronger, but because it is better adapted to the element in which it lives. A Texas bull is stronger than a mosquito, but in an autumn drought the bull dies, the mosquito lives. Fitness to survive is simply fittedness, and has nothing to do with strength or courage, or intelligence or cunning as such, but only with adjustments as fit or unfit to the world around. A prize-fighter is stronger than a cripple; but in the environment of modern life the cripple is cared for by the people, is judged fit to live by a moral world, while the pugilist, handicapped by his very health, has to conduct his own struggle for existence. Physical fitness here is actually a disqualification; what was once unfitness is now fitness to survive. As we rise in the scale the physical fitness of the early world changes to fitness of a different quality, and this law becomes the guardian of a moral order. In one era the race is to the swift, in another the meek inherit the earth. In a material world social survival depends on wealth, health, power; in a moral world the fittest are the weak, the pitiable, the poor. Thus there comes a time when this very law, in securing survival for those who would otherwise sink and fall, is the minister of moral ends.—DRUMMOND *Ascent of Man*, ch. 6, p. 209. (J. P., 1900.)

3339. ——— ——— *Natural Interference with.*—Apes that abstract a thorn from a wounded comrade, and protect the weak or wounded, defy the laws of the struggle for existence.—KOKEN *Die Vorwelt*, p. 635. (Translated for *Scientific Side-Lights.*)

3340. SURVIVAL OF WEAPON AS SYMBOL OF POWER—*The Mace Is the War-club of Primitive Man.*—Among the simplest of weapons is the thick stick or cudgel, which when heavier or knobbed passes into the club. Rude champions have delighted in the ferocious roughness of such a gnarled club as Hercules in the pictures carries on his shoulder, while others spent their leisure hours in elegant shaping and carving, like that of the South Sea Island clubs to be seen in museums. From savage through barbaric times the war-club lasted on into the Middle Ages of Europe, when knights still smashed helmets in with their heavy maces. Mostly used as a weapon, it only now and then appears in peaceful arts, as in the ribbed clubs with which the Polynesian women beat out bark cloth. It is curious to see how the rudest of primitive weapons, after its serious warlike use has ceased, survives as a symbol of power, when the mace is carried as emblem of the royal authority, and is laid on the table during the sitting of Parliament or the Royal Society.—TYLOR *Anthropology*, ch. 8, p. 184. (A., 1899.)

3341. SUSPENSE, EVIL HELD IN—*May Burst Forth Anew—Antiseptics vs. Germicides—Cold Merely Represses Bacteria.*—In a cold temperature, as a general rule, bacteria do not multiply with the same rapidity as at blood-heat. Within the limits of a moist perimeter the air is, to all intents and purposes, germ-free. Direct sunlight has a definitely germicidal effect in the course of time upon some of the most virulent bacteria we know. Here, then, are three examples of physical agents—low temperature, moist perimeter, sunlight—which, if strong enough in degree, or acting for a long enough period of time, become first antiseptics and then germicides. Yet for a limited period they have no injurious effect upon bacteria.—NEWMAN *Bacteria*, ch. 9, p. 323. (G. P. P., 1899.)

3342. SUSPENSE, IMPATIENCE OF—*Longing for Action of Some Kind.*—Certain motives are more or less constantly in play [in time of deliberation]. One of these is impatience of the deliberative state; or, to express it otherwise, proneness to act or to decide merely because action and decision are, as such, agreeable, and relieve the tension of doubt and hesitancy. Thus it comes that we will often take any course whatever which happens to be most vividly before our minds, at the moment when this impulse to decisive action becomes extreme. —JAMES *Psychology*, vol. ii, ch. 26, p. 529. (H. H. & Co., 1899.)

3343. SUSTENANCE STORED IN BODY FOR LONG FAST—*Summer Torpidity of Lemuroids.*—Certain small nocturnal lemuroids inhabit Madagascar. . . . They have also an interesting peculiarity of a temporary nature; this is their tendency to accumulate a quantity of fat in certain parts of the body, especially at the root of the tail, which becomes of an exceedingly large size. This peculiarity of structure is related to a peculiarity of habit, for during the dry season they retire into the holes of trees, coil themselves up, and pass the whole period in sleep, as bats with us hibernate in winter. When, with the advent of the rainy season, they rouse themselves again, their fat has disappeared, having

served to nourish them during their period of torpor.—MIVART *Types of Animal Life*, ch. 12, p. 343. (L. B. & Co., 1893.)

3344. SWIFTNESS OF EARTH'S REVOLUTION—*Man Like Dust on Flying Cannon-ball.*—In order to accomplish, as it does in 365¼ days, this immense distance round the sun our sphere is obliged to travel a distance of 2,544,000 kilometers [1,580,765.28 miles] a day, or 106,000 kilometers [65,865.22 miles] an hour, or 29 kilometers [18 miles] a second! This is an absolutely demonstrated mathematical fact. . . . We sail, then, in immensity with a velocity eleven hundred times quicker than that of an express train. . . . This velocity of our globe in its celestial orbit is seventy-five times swifter than that of a cannon-ball.

Upon this moving globe we live, almost in the same situation as grains of dust adhering to the surface of an enormous cannon-ball shot into immensity. * * * Sharing absolutely in all the motions of the globe, with all that surrounds us, we cannot perceive these motions, and we can only detect them from observations of the stars, which do not participate in the motion. Marvelous sidereal mechanism—the force which transports our planet is exercised without an effort, without friction, and without shocks in the midst of absolute silence in the eternal heavens. Smoother than the barge upon the limpid river, smoother than the gondola moving on the mirror of the Venetian canals, the earth glides majestically in its ideal orbit, showing no perceptible trace of the powerful force which guides it. Thus, but not with such perfection, glides the solitary balloon in the midst of the transparent air. How many times, entrusted to the car of the aerial ship, either during the bright hours of the day above the verdant fields, or in the darkness of night, with the melancholy light of the moon and stars—how many times have I compared the glorious course of the balloon in the atmosphere to that of the earth in space!—FLAMMARION *Popular Astronomy*, bk. i, ch. 1, p. 8. (A.)

3345. SWIFTNESS OF MOTION—*A Gnat's Wings—Corresponding Quickness of Perception.*—" A gnat's wings," says Mr. Spencer, " make ten or fifteen thousand strokes a second. Each stroke implies a separate nervous action. Each such nervous action or change in a nervous center is probably as appreciable by the gnat as is a quick movement of his arm by a man. And if this, or anything like this, is the fact, then the time occupied by a given external change, measured by many movements in the one case, must seem much longer than in the other case, when measured by one movement."—JAMES *Psychology*, vol. i, ch. 15, p. 639. (H. H. & Co., 1899.)

3346. SYMPATHY A GENUINE HUMAN IMPULSE—*Not a Result of Calculation.*—Sympathy is an emotion as to whose instinctiveness psychologists have held hot debate, some of them contending that it is no primitive endowment, but, originally at least, the result of a rapid calculation of the good consequences to ourselves of the sympathetic act. Such a calculation, at first conscious, would grow more unconscious as it became more habitual, and at last, tradition and association aiding, might prompt to actions which could not be distinguished from immediate impulses. It is hardly needful to argue against the falsity of this view. Some forms of sympathy, that of mother with child, for example, are surely primitive, and not intelligent forecasts of board and lodging and other support to be reaped in old age. Danger to the child blindly and instantaneously stimulates the mother to actions of alarm or defense. Menace or harm to the adult beloved or friend excites us in a corresponding way, often against all the dictates of prudence. It is true that sympathy does not necessarily follow from the mere fact of gregariousness. Cattle do not help a wounded comrade; on the contrary, they are more likely to despatch him. But a dog will lick another sick dog, and even bring him food; and the sympathy of monkeys is proved by many observations to be strong. In man, then, we may lay it down that the sight of suffering or danger to others is a direct exciter of interest, and an immediate stimulus, if no complication hinders, to acts of relief.—JAMES *Psychology*, vol. ii, ch. 24, p. 410. (H. H. & Co., 1899.)

3347. SYMPATHY AND KINDNESS AMONG APES—Here is a case which I myself witnessed at the Zoological Gardens, and published in the *Quarterly Journal of Science*, from which I now quote: " A year or two ago there was an Arabian baboon and an Anubis baboon confined in one cage, adjoining that which contained a dog-headed baboon. The Anubis baboon passed its hand through the wires of the partition, in order to purloin a nut which the large dog-headed baboon had left within reach—expressly, I believe, that it might act as a bait. The Anubis baboon very well knew the danger he ran, for he waited until his bulky neighbor had turned his back upon the nut with the appearance of having forgotten all about it. The dog-headed baboon, however, was all the time slyly looking round with the corner of his eye, and no sooner was the arm of his victim well within his cage than he sprang with astonishing rapidity and caught the retreating hand in his mouth. The cries of the Anubis baboon quickly brought the keeper to the rescue, when, by dint of a good deal of physical persuasion, the dog-headed baboon was induced to leave go his hold. The Anubis baboon then retired to the middle of his cage, moaning piteously, and holding the injured hand against his chest while he rubbed it with the other one. The Arabian baboon now approached him from the

top part of the cage, and while making a soothing sound very expressive of sympathy, folded the sufferer in his arms—exactly as a mother would her child under similar circumstances. It must be stated, also, that this expression of sympathy had a decidedly quieting effect upon the sufferer, his moans becoming less piteous so soon as he was enfolded in the arms of his comforter; and the manner in which he laid his cheek upon the bosom of his friend was as expressive as anything could be of sympathy appreciated. This really affecting spectacle lasted a considerable time, and while watching it I felt that, even had it stood alone, it would in itself have been sufficient to prove the essential identity of some of the noblest among human emotions with those of the lower animals."—ROMANES *Animal Intelligence*, ch. 17, p. 474. (A., 1899.)

3348. SYMPATHY, HINDRANCES TO—*Cruelty of Mobs.*—Sympathy is peculiarly liable to inhibition from other instincts which its stimulus may call forth. The traveler whom the good Samaritan rescued may well have prompted such instinctive fear or disgust in the priest and Levite who passed in front of him, that their sympathy could not come to the front. Then, of course, habits, reasoned reflections, and calculations may either check or reenforce one's sympathy, as may also the instincts of love or hate, if these exist, for the suffering individual. The hunting and pugnacious instincts, when aroused, also inhibit our sympathy absolutely. This accounts for the cruelty of collections of men hounding each other on to bait or torture a victim. The blood mounts to the eyes, and sympathy's chance is gone.—JAMES *Psychology*, vol. ii, ch. 24, p. 411. (H. H. & Co., 1899.)

3349. SYMPATHY WITH PICTURED EMOTION—As emotions are described in novels, they interest us, for we are made to share them. We have grown acquainted with the concrete objects and emergencies which call them forth, and any knowing touch of introspection which may grace the page meets with a quick and feeling response.—JAMES *Psychology*, vol. ii, ch. 25, p. 448. (H. H. & Co., 1899.)

3350. SYMPATHY WITH STORM AND DARKNESS—*The Wild Beast's Response to the Terrible in Nature.*—If an African lion is to be seen in his glory, he must be looked at by the lightning's glare. It is amid tempest and gloom that the full proportions of his nature come forth. So with this lion of another world [a captive puma]. Many a time in the course of those nightly interviews . . . he roused himself from an intense contemplation of his companion, disturbed by thunder and the tumult without. Then while the wind blew unequally, roared through swaying branches, or mourned around the walls that shut him in, he quickened under the influence of overtones in Nature which human beings cannot hear. Storm and darkness wrought upon him as they will not do upon man. Beyond what was visible or audible there was something that came from within himself; something that wove "the waste fantasies" of his dreams together, and gave character and purpose to ideation. He showed it in profoundly suggestive pantomime. But what "air-drawn" shapes were followed with those long, swift, soft yet heavy steps, on what his eyes were fixed, what feelings and fancies engrossed and transfigured him, gave that fierce energy, and led him in their train, are unknowable. They had no voice, but only with mute motions pointed backward to a past in which humanity shared no part, and which it cannot explore.—PORTER *Wild Beasts*, p. 290. (A., 1894.)

3351. SYNTHESIS, CHEMICAL—*Building Greater than Destruction—Vital Products Chemically Produced.*—One of the marked features of modern chemistry has been in the widening of the field of synthetic research. The building of a molecule requires far more skill than its destruction, and therefore, as the knowledge of chemical principles has advanced, and as the skill of the analyst has increased, it has been possible to put together the chemical elements into increasingly more complex and more valuable forms. Following out researches of this kind, the chemist has been able to produce by synthesis hundreds of compounds which a quarter of a century ago were supposed to be exclusively formed by the activity of the so-called vital forces.—WILEY *Relations of Chemistry to Industrial Progress (Address at Purdue University, Lafayette, Ind., 1896*, p. 28).

3352. SYSTEM, COPERNICAN—*Humble Worker Solves Mystery of Universe—Patience and Exactness of Science.*—The hypothesis of the earth's motion had been suggested long before his [Copernicus's] birth on this planet. This theory counted partisans in his time. But he—he did his work. He examined it with the patience of an astronomer, the rigor of a mathematician, the sincerity of a sage, and the mind of a philosopher. He demonstrated it in his works. Then he died without seeing it understood, and it was not till a century after his death that astronomy adopted it and popularized it by teaching it. However, Copernicus is really the author of the true system of the world, and his name will remain respected to the end of time.

This great man was neither potentate, prince, nor official personage, nor covered with titles more or less sonorous and more or less vain. He was a modest physician, the friend of humanity and the friend of science, consecrating his whole life to the study of Nature, nobly indifferent as well to fortune as to glory. He was the son of a Polish baker, and became by his own

labors the greatest man of his age. The physician became a priest, a physician of the soul, and the position of a canon assured to him the calm and tranquil life which he preferred. His uncle was a bishop, and was sometimes astonished that he should "lose his time" working at astronomy.—FLAMMARION *Popular Astronomy*, bk. iv, ch. 1, p. 343. (A.)

3353. SYSTEMS MERELY ARTIFICIAL MUST PERISH—*The Linnean System of Botany.*—The botany of Linnæus, a purely artificial system, was a splendid contribution to human knowledge, and did more in its day to enlarge the view of the vegetable kingdom than all that had gone before. But all artificial systems must pass away. None knew better than the great Swedish naturalist himself that his system, being artificial, was but provisional. Nature must be read in its own light. And as the botanical field became more luminous the system of Jussieu and De Candolle slowly emerged as a native growth, unfolded itself as naturally as the petals of one of its own flowers, and forcing itself upon men's intelligence as the very voice of Nature, banished the Linnean system forever.—DRUMMOND *Natural Law in the Spiritual World*, int., p. 18. (H. Al.)

3354. SYSTEMS OF RELATED COMETS—*A Common Origin in Distant Space.*—The idea of cometary systems was first suggested by Thomas Clausen in 1831. It was developed by the acute inquiries of the late M. Hoek, director of the Utrecht Observatory, in 1865 and some following years. He found that in quite a considerable number of cases the paths of two or three comets had a common point of intersection far out in space, indicating with much likelihood a community of origin. This consisted, according to his surmise, in the disruption of a parent mass during its sweep round the star latest visited. Be this as it may, the fact is undoubted that numerous comets fall into groups, in which similar conditions of motion betray a preexistent physical connection.—CLERKE *History of Astronomy*, pt. ii, ch. 11, p. 438. (Bl., 1893.)

3355. TANGIBLE, THE, HELD TO BE THE REAL—*Objects Hurt or Help Only by Contact—Other Senses Are but Anticipatory Touch.*—Why do we thus so markedly select the *tangible* to be the real? Our motives are not far to seek. The tangible qualities are the least fluctuating. When we get them at all we get them the same. The other qualities fluctuate enormously as our relative position to the object changes. Then, more decisive still, the tactile properties are these most intimately connected with our weal or woe. A dagger hurts us only when in contact with our skin, a poison only when we take it into our mouths, and we can only use an object for our advantage when we have it in our muscular control. It is as tangibles, then, that things concern us most; and the other senses, so far as their practical use goes, do but warn us of what tangible things to expect. They are but organs of anticipatory touch, as Berkeley has with perfect clearness explained.—JAMES *Psychology*, vol. ii, ch. 21, p. 306. (H. H. & Co., 1899.)

3356. TASKS, CONTRASTED, FOR MAN AND WOMAN—*Woman's Bias toward the Domestic Life.*—Among primitive peoples, as largely in modern times, "The tasks which demand a powerful development of muscle and bone, and the resulting capacity for intermittent spurts of energy, involving corresponding periods of rest, fall to the man; the care of the children and all the various industries which radiate from the hearth, and which call for an expenditure of energy more continuous, but at a lower tension, fall to the woman." [Havelock Ellis, "Man and Woman," p. 2.] Whether this or any theory of the origin of sex be proved or unproved, the fact remains, and is everywhere emphasized in Nature, that a certain constitutional difference exists between male and female, a difference inclining the one to a robuster life, and implanting in the other a certain mysterious bias in the direction of what one can only call the womanly disposition.*—DRUMMOND *Ascent of Man*, ch. 7, p. 256. (J. P., 1900.)

3357. TASKS INCREASED WITH POWER—*New Problems of Astronomy.*—The means at the disposal of astronomers have not multiplied faster than the tasks imposed upon them. Looking back to the year 1800, we cannot fail to be astonished at the change. The comparatively simple and serene science of the heavenly bodies known to our predecessors, almost perfect so far as it went, incurious of what lay beyond its grasp, has developed into a body of manifold powers and parts, each with its separate mode and means of growth, full of strong vitality, but animated by a restless and unsatisfied spirit, haunted by the sense of problems unsolved, and tormented by conscious impotence to sound the immensities it perpetually confronts.—CLERKE *History of Astronomy*, pt. ii, ch. 13, p. 526. (Bl., 1893.)

3358. TASTE AMONG PRIMITIVE WOMEN—*Early Needle and Thread—Geometric Patterns.*—The first sewing-machine was a needle or bodkin of bone, with dainty sinew thread from the leg of the antelope, and for thimble a little leather cap over the ends of the fingers. Coarse, indeed, the apparatus, but the hand was deft, the eye was true, the sense of beauty was there, and so that needlewoman of long ago

* —— "but this is fixt
As are the roots of earth and base of all,
Man for the field and woman for the hearth;
Man for the sword and for the needle she;
Man with the head and woman with the heart."
—TENNYSON *Princess*, can. v, st. 16, l. 9.

wrought in fur from the mammals, feathers from the birds, grasses from the fields, shells from the sea, wings from the beetle, and skins of snakes, with tasteful geometric figures. You do err who think those ancient needlewomen had no taste. It would be hard to invent a pattern now that was unfamiliar to them.—MASON *The Birth of Invention (Address at Centenary of American Patent System, Washington, D. C., 1891, Proceedings of the Congress*, p. 408).

3359. TASTE IN MUSIC, PROGRESS OF—*Greeks and Japanese—Handel—Beethoven—Wagner.*—The pains and pleasures of tones, tastes, and smells, altho still immediately sensuous, are becoming, as development goes on, more and more matters of determination according to ideal standards. The ear of the Greeks scarcely tolerated as agreeable the "imperfect consonances" of the major and minor third. But Handel accepted "fourths," Beethoven "fifths," and the modern Wagnerian music pleases many lovers of music, altho tolerating the widest range of discords. Some nations, whose music is quite undeveloped (notably, for example, the Japanese), find intervals agreeable which are intolerable to us, apparently because of the association of the tones with the sad, weird sounds of Nature, so "consonant" with the national tone of feeling.—LADD *Psychology*, ch. 10, p. 198. (S., 1899.)

3360. TASTE ROUSES DIGESTIVE ORGANS—*Function of the Palate—Unspoiled Appetite a Guide to Nutrition—Nature's Chemistry.*—It would seem that gelatin alone, altho containing the elements required for nutrition, requires something more to render it digestible. We shall probably be not far from the truth if we picture it to the mind as something too smooth, too neutral, too inert, to set the digestive organs at work, and that it therefore requires the addition of a decidedly sapid something that shall make these organs act. I believe that the proper function of the palate is to determine our selection of such materials; that its activity is in direct sympathy with that of all the digestive organs, and that if we carefully avoid the vitiation of our natural appetites, we have in our mouths and the nervous apparatus connected therewith a laboratory that is capable of supplying us with information concerning some of the chemical relations of food which is beyond the grasp of the analytical machinery of the ablest of our scientific chemists.—WILLIAMS *Chemistry of Cookery*, ch. 4, p. 40. (A., 1900.)

3361. TEA IN CHINA—*A Nation Supplied with Sterilized Water.*—In the country which over all others combines a very large population with a very small allowance of cleanliness, the ordinary drink of the people is boiled water flavored by an infusion of leaves. These people, the Chinese, seem, in fact, to have been the inventors of boiled-water beverages. Judging from travelers' accounts of the state of the rivers, rivulets, and general drainage and irrigation arrangements of China, its population could scarcely have reached its present density if Chinamen were drinkers of raw instead of cooked water. This is especially remarkable in the case of such places as Canton, where large numbers are living afloat on the mouths of sewage-laden rivers or estuaries. The ordinary every-day domestic beverage is a weak infusion of tea, made in a large teapot, kept in a padded basket to retain the heat. The whole family is supplied from this reservoir. The very poorest drink plain hot water, or water tinged by infusing the spent tea-leaves rejected by their richer neighbors.—WILLIAMS *Chemistry of Cookery*, ch. 2, p. 13. (A., 1900.)

3362. TEACHABLENESS DISTINGUISHES HUMANITY—*Man Can Learn.*—It is not too much to say that the difference between man and all other living creatures, in respect of teachableness, progressiveness, and individuality of character, surpasses all other differences of kind that are known to exist in the universe.—FISKE *Destiny of Man*, ch. 6, p. 56. (H. M. & Co., 1900.)

3363. TEACHING NOT A SUBSTITUTE FOR SEEING—*Instruction about Light Given to the Blind.*—In training-institutions for the blind they teach the pupils as much about light as in ordinary schools. Reflection, refraction, the spectrum, the ether-theory, etc., are all studied. But the best taught born-blind pupil of such an establishment yet lacks a knowledge which the least instructed seeing baby has. They can never show him what light is in its "first intention"; and the loss of that sensible knowledge no book-learning can replace.—JAMES *Psychology*, vol. ii, ch. 17, p. 4. (H. H. & Co., 1899.)

3364. TELEGRAPH, ELECTRIC—*Foreshadowed in the Animal Economy.*—We must look for the soul in the brain as the only province in the body known to possess sensibility. Just as the center station of our post-office is in communication with the uttermost boundaries of our monarchy by means of its gigantic spider-web of copper wires, so the soul in its office, the brain, is ceaselessly receiving messages through its telegraph wires, the nerves, from all of the limits of its kingdom, the body, and distributing commands in all directions to its officials, the muscles.

As he glances at the mute, indifferent wire, who can discern whether the message, trembling with lightning celerity along its course, is bringing news of a victory, or a stock quotation, or some unextinguishable disgrace to himself? Thus, no matter what storm may be raging within the nerves, they never change their external appearance, tho they deliver messages that vary a thousand-fold, or whether they carry from the instru-

ments of the senses to the brain, or return from the brain to the members out in the world. And just as the brain cannot distinguish from which point in any thread of perception the news of pain has arrived, since a knock on the elbow may be felt in the hand, so the telegraph operator cannot know from what station a despatch is being sent until the name of that station is announced. And if at any point the wire is destroyed, tho a mob may riot or a run of ice threaten to destroy, no officials will receive warning. And just so, if the nerves of sensation in a man's leg were paralyzed, the burning of his foot to ashes would not disturb his sleep any more than if that leg were of wood.

We see, then, that the miracle of our age, the electric telegraph, was prefigured long ago in the animal machine. But the similarity between the two kinds of apparatus, the nervous system and the electric telegraph, is still more profound. It is more than similarity; it is relationship, corresponding not merely in their effects, but also in their causes.—Du Bois-Reymond *Tierische Bewegung (a Lecture)*, in *Virchow und Holtzendorff's Sammlung wissenschaftlicher Vorträge.* (Translated for *Scientific Side-Lights.)*

3365. ——— ——— *Long Preparation for—Unity of the Host of Discoverers.*—The ancients discovered the electricity of amber; and Gilbert, in the year 1600, extended the discovery to other bodies. Then followed Boyle, Von Guericke, Gray, Canton, Du Fay, Kleist, Cunæus, and your own Franklin. But their form of electricity, tho tried, did not come into use for telegraphic purposes. Then appeared the great Italian Volta, who discovered the source of electricity which bears his name, and applied the most profound insight and the most delicate experimental skill to its development. Then arose the man who added to the powers of his intellect all the graces of the human heart, Michael Faraday, the discoverer of the great domain of magneto-electricity. Oersted discovered the deflection of the magnetic needle, and Arago and Sturgeon the magnetization of iron by the electric current. The voltaic circuit finally found its theoretic Newton in Ohm; while Henry, of Princeton, who had the sagacity to recognize the merits of Ohm while they were still decried in his own country, was at this time in the van of experimental inquiry.

In the works of these men you have all the materials employed at this hour, in all the forms of the electric telegraph. Nay, more; Gauss, the celebrated astronomer, and Weber, the celebrated natural philosopher, both professors in the University of Göttingen, wishing to establish a rapid mode of communication between the observatory and the physical cabinet of the university, did this by means of an electric telegraph. Thus, before your practical men appeared upon the scene, the force had been discovered, its laws investigated and made sure, the most complete mastery of its phenomena had been attained—nay, its applicability to telegraphic purposes demonstrated—by men whose sole reward for their labors was the noble excitement of research, and the joy attendant on the discovery of natural truth.—Tyndall *Lectures on Light*, lect. 6, p. 220. (A., 1893.)

3366. TELEPATHY — *Communication without Speech—A Possible New Step of Evolution.*—Is this the end? It is by no means likely. The mind is feeling about already for more perfect forms of human intercourse than telegraphed or telephoned words. As there was a stage in the ascent of man at which the body was laid aside as a finished product, and made to give way to mind, there may be a stage in the evolution of mind when its material achievements—its body—shall be laid aside and give place to a higher form of mind. Telepathy has already become a word, not a word for thought-reading or muscle-reading, but a scientific word. It means "the ability of one mind to impress, or to be impressed by another mind, otherwise than through the recognized channels of sense." By men of science, adepts in mental analysis, aware of all sources of error, armed against fraud, this subject is now being made the theme of exhaustive observation.—Drummond *Ascent of Man*, ch. 5, p. 183. (J. P., 1900.)

3367. TELEPHONE ANTICIPATES THE EYE—*Passage of Lightning Heard before Flash Is Seen.*—The sound produced in the telephone by lightning, even when so distant that only the flash can be seen in the horizon, and no thunder can be heard, is very characteristic—something like the quenching of a drop of molten metal in water, or the sound of a distant rocket; but the remarkable circumstance for us in this history is that this sound is always heard just before the flash is seen, showing that there is an inductive disturbance of the electricity overhead, due to the distant concentration preceding the disruptive discharge. Thus, on November 18, 1877, these peculiar sounds were heard in Providence, and the papers next morning explained them by reporting thunder-storms in Massachusetts. Sounds like those produced by lightning, but fainter, are almost always heard many hours before a thunder-storm actually breaks.—Fahie *Wireless Telegraphy*, p. 80. (D. M. & Co., 1900.)

3368. TELESCOPE EXTENDS DOMAIN OF HUMAN MIND—*Gives Mathematics Nobler Problems—Perception Reacts upon Thought.*—The transition from natural to telescopic vision which characterizes the first ten years of the seventeenth century was more important to astronomy (the knowledge of the regions of space) than the year 1492 (that of the discoveries of Co-

lumbus) in respect to our knowledge of terrestrial space. It not only infinitely extended our insight into creation, but also, besides enriching the sphere of human ideas, raised mathematical science to a previously unattained splendor by the exposition of new and complicated problems. Thus the increased power of the organs of perception reacts on the world of thought, to the strengthening of intellectual force and the ennoblement of humanity. To the telescope alone we owe the discovery in less than two and a half centuries of thirteen new planets, of four satellite systems (the four moons of Jupiter, eight satellites of Saturn, four or perhaps six of Uranus, and one of Neptune), of the sun's spots and faculæ, the phases of Venus, the form and height of the lunar mountains, the wintry polar zones of Mars, the belts of Jupiter and Saturn, the rings of the latter, the interior planetary comets of short periods of revolution, together with many other phenomena which likewise escape the naked eye. While our own solar system, which so long seemed limited to six planets and one moon, has been enriched in the space of 240 years with the discoveries to which we have alluded, our knowledge regarding successive strata of the region of the fixed stars has unexpectedly been still more increased. Thousands of nebulæ, stellar swarms, and double stars have been observed. The changing position of the double stars which revolve round one common center of gravity has proved, like the proper motion of all fixed stars, that forces of gravitation are operating in those distant regions of space, as in our own limited, mutually disturbing planetary spheres, . . . The astronomical knowledge of the solar system has gradually extended to that of a system of the universe.—HUMBOLDT *Cosmos*, vol. iii, p. 61. (H., 1897.)

3369. TEMPERAMENT DETERMINING ACTION—*A Wide-spread Belief—Incorporated in Language.*—The various words in use to characterize the different temperaments are highly instructive. They show the persistent and wide-spread impression that the lines are laid down, within which the development of the individual takes place, by some form of physical influence that operates upon the original "make-up" of the individual. When men believed in astrology they found in the determining power of the planets a reason why some were "Jovial," others "Saturnine," and still others "Mercurial" in temperament. When they more justly recognized the influence of the circulatory and digestive systems over every one's "temper" of mind, they came to speak of the "sanguine" (or "full-blooded") man, of the "choleric" (or "full of bile") man, of the "melancholic" (or "full of black bile") man, and of the "phlegmatic" (or "full-phlegmed") man. Thus, in Shakespeare's "King John" we read:

> Or if that surly spirit, melancholy,
> Had baked thy blood and made it heavy thick, which
> Else, runs tickling up and down the veins.

—LADD *Psychology*, ch. 27, p. 649. (S., 1899.)

3370. TEMPERANCE OF SAVAGE WOMEN—A remarkable result of abstinence and morality is the fact that neither in America nor in Africa nor in the Indo-Pacific were women guilty of indulgence in the native forms of intoxication. In the New Hebrides and elsewhere Turner found that the women and girls were total abstainers from drinking kava. "Drunkenness," says Dodge, "is not a female vice. In all my experience I have never seen a drunken Indian woman." Similar testimony could be gathered concerning beer-drinking in Africa. —MASON *Woman's Share in Primitive Culture*, ch. 10, p. 235. (A., 1894.)

3371. TEMPERATURE IN EUROPE AND AMERICA—*Land a Conductor of Cold—Ocean Tends to Produce Uniform Climate.*—On comparing the two continents of Europe and America, it is found that places in the same latitudes have sometimes a mean difference of temperature amounting to 11°, or even in a few cases to 17° F.; and some places on the two continents, which have the same mean temperature, differ from 7° to 17° in latitude. Thus, Cumberland House, in North America, having the same latitude (54° N.) as the city of York in England, stands on the isothermal line of 32°, which in Europe rises to the North Cape, in lat. 71°, but its summer heat exceeds that of Brussels or Paris. The principal cause of greater intensity of cold in corresponding latitudes of North America, as contrasted with Europe, is the connection of America with the polar circle, by a large tract of land, some of which is from three to five thousand feet in height; and, on the other hand, the separation of Europe from the arctic circle by an ocean. The ocean has a tendency to preserve everywhere a mean temperature, which it communicates to the contiguous land, so that it tempers the climate, moderating alike an excess of heat or cold. The elevated land, on the other hand, rising to the colder regions of the atmosphere, becomes a great reservoir of ice and snow, arrests, condenses, and congeals vapor, and communicates its cold to the adjoining country. For this reason, Greenland, forming part of a continent which stretches northward to the 82d degree of latitude, experiences under the 60th parallel a more rigorous climate than Lapland under the 72d parallel.—LYELL *Principles of Geology*, bk. i, ch. 7, p. 94. (A., 1854.)

3372. TEMPERATURE OF THE DEEP SEA — *Depths Intensely Cold.* — The temperature of the water in the abyss is by no means constant for a constant depth, nor does it vary with the latitude. It is true that, as a rule, the water is colder at greater

depths than in shallower ones, and that the deeper the thermometer is lowered into the sea the lower the mercury sinks. This is consistent with physical laws. If there is any difference at all in the temperature of a column of water that has had time to settle, the thermometer will always reach its highest point at the top of the column and its lowest at the bottom, for the colder particles, being of greater specific gravity than the warmer ones, will sink, and the warmer ones will rise.—HICKSON *Fauna of the Deep Sea*, ch. 2, p. 28. (A., 1894.)

3373. TEMPERATURES DIFFER IN DEEP SEA—*Ridges Shut Off Polar Cold.*—If the ocean were a simple basin somewhat deeper at the equator than at the poles, the cold water at the poles would gradually sink down the slopes of the basin towards the latitude of the equator, and the bottom temperature of the water would be constant all the world over. A few hills here and there would not affect the general statement that for a constant depth the temperature of the lowest stratum of water would be constant. But in some places ridges occur stretching across the oceans from continent to continent, and these ridges shut off the cold water at the bottom of the sea on the polar side from reaching the bottom of the sea on the equator side. . . . These facts then show that, altho at the bottom of the deep sea the water is always very cold, the degree of coldness is by no means constant in the same latitude for the same depth.—HICKSON *Fauna of the Deep Sea*, ch. 2, p. 31. (A., 1894.)

3374. TENACITY OF LIFE OF BACTERIA—*Disease-germs Living in Soil Sixteen Years.*—Farm soils have, as is well known, been contaminated with anthrax in the late summer or autumn, and have retained the infectious virus till the following spring, and it has even then cropped up again in the hay of the next season. In 1881 Miquel took some samples of soil at a depth of ten inches, containing six and a half million bacteria per gram. After drying for two days at 30° C., the dust was placed in hermetically sealed tubes, which were put aside in a dark corner of the laboratory for sixteen years. Upon reexamination it is reported that more than three million germs per gram were still found, amongst them the specific bacillus of tetanus. Whether or not there is any fallacy in these actual figures, there is abundant evidence in support of the fact that bacteria, non-pathogenic and pathogenic, can and do retain their vitality, and sometimes even their virulence, for almost incredibly long periods of time.—NEWMAN *Bacteria*, ch. 5, p. 174. (G. P. P., 1899.)

3375. TENDERNESS OF ANTS TO THEIR YOUNG—*Feminine Care and Delicacy toward the Newly Born.*—After remaining some days in this [pupal] state they [ants] emerge as perfect insects. In many cases, however, they would perish in the attempt if they were not assisted; and it is very pretty to see the older ants helping them to extricate themselves, carefully unfolding their legs and smoothing out the wings, with truly feminine tenderness and delicacy. Our countryman, Gould, was the first to observe, and the fact has since been fully confirmed by Forel, that the pupæ are unable to emerge from the cocoons without the assistance of the workers.—AVEBURY *Ants, Bees, and Wasps*, ch. 1, p. 7. (A., 1900.)

3376. TERROR OF DARKNESS AND GLOOM HEREDITARY—*Caverns Inspire Dread.*—Black things, and especially dark places, holes, caverns, etc., arouse a peculiarly gruesome fear. This fear, as well as that of solitude, of being "lost," are explained after a fashion by ancestral experience. Says Schneider:

"It is a fact that men, especially in childhood, fear to go into a dark cavern or a gloomy wood. This feeling of fear arises, to be sure, partly from the fact that we easily suspect that dangerous beasts may lurk in these localities—a suspicion due to stories we have heard and read. But, on the other hand, it is quite sure that this fear at a certain perception is also directly inherited. Children who have been carefully guarded from all ghost-stories are nevertheless terrified and cry if led into a dark place, especially if sounds are made there. Even an adult can easily observe that an uncomfortable timidity steals over him in a lonely wood at night, altho he may have the fixed conviction that not the slightest danger is near.

"This feeling of fear occurs in many men even in their own house after dark, altho it is much stronger in a dark cavern or forest. The fact of such instinctive fear is easily explicable when we consider that our savage ancestors through innumerable generations were accustomed to meet with dangerous beasts in caverns, especially bears, and were for the most part attacked by such beasts during the night and in the woods, and that thus an inseparable association between the perceptions of darkness of caverns and woods, and fear took place and was inherited."—JAMES *Psychology*, vol. ii, ch. 24, p. 418. (H. H. & Co., 1899.)

3377. TERROR OF EARTHQUAKE UNCONQUERABLE—Dr. Tschudi, in his interesting work, "Travels in Peru," describes strikingly the effect of an earthquake upon the native and upon the stranger. "No familiarity with the phenomenon can blunt this feeling. The inhabitant of Lima, who from childhood has frequently witnessed these convulsions of Nature, is roused from his sleep by the shock, and rushes from his apartment with the cry of *Misericordia!* The foreigner from the north of Europe, who knows nothing of earthquakes but by description, waits with impatience to feel

the movement of the earth, and longs to hear with his own ear the subterranean sounds which he has hitherto considered fabulous. With levity he treats the apprehension of a coming convulsion, and laughs at the fears of the natives; but as soon as his wish is gratified he is terror-stricken, and is involuntarily prompted to seek safety in flight."—HUMBOLDT *Cosmos*, vol. i, p. 215. (H., 1897.)

3378. TERROR OF HAWK OVERPOWERS MULTITUDES OF BIRDS—The sudden appearance overhead of this hawk [the marsh-hawk] produces an effect wonderful to witness. I have frequently seen all the inhabitants of a marsh struck with panic, acting as if demented, and suddenly grown careless to all other dangers; and on such occasions I have looked up confident of seeing the sharp-winged death suspended above them in the sky. All birds that happen to be on the wing drop down as if shot into the reeds or water; ducks away from the margin stretch out their necks horizontally and drag their bodies, as if wounded, into closer cover; not one bird is found bold enough to rise up and wheel about the marauder—a usual proceeding in the case of other hawks; while, at every sudden stoop the falcon makes, threatening to dash down on his prey, a low cry of terror rises from the birds beneath; a sound expressive of an emotion so contagious that it quickly runs like a murmur all over the marsh, as if a gust of wind had swept moaning through the rushes. As long as the falcon hangs overhead, always at a height of about forty yards, threatening at intervals to dash down, this murmuring sound, made up of many hundreds of individual cries, is heard swelling and dying away, and occasionally, when he drops lower than usual, rising to a sharp scream of terror.—HUDSON *Naturalist in La Plata*, ch. 5, p. 97. (C. & H., 1895.)

3379. TERROR OF THE NATIONS PASSES HARMLESSLY BY—*Earth Wrapped for Hours in the Tail of a Comet.*—On June 30, 1861, the earth passed, for the second time in this century, through the tail of a great comet. Many of our readers must remember the unexpected disclosure, on the withdrawal of the sun below the horizon on that evening, of an object so remarkable as to challenge universal attention. A golden-yellow planetary disk, wrapt in dense nebulosity, shone out while the June twilight of these latitudes was still in its first strength. . . . Its tail stretched outward just along the line of intersection of its own with the terrestrial orbit to an extent of fifteen million miles, so that our globe, happening to pass at the time, found itself during some hours involved in the flimsy appendage. No perceptible effects were produced by the meeting; it was known to have occurred by theory alone. A peculiar glare in the sky, thought by some to have distinguished the evening of June 30, was, at best, inconspicuous. Nor were there any symptoms of unusual electrical excitement. —CLERKE *History of Astronomy*, pt. ii, ch. 10, p. 398. (Bl., 1893.)

3380. TERROR, SUPERSTITIOUS—*Great Meteoric Storm of 1833.*—The most notable modern one [shower of meteors] was on November 13, 1833, and this was visible over much of the North-American continent, forming a spectacle of terrifying grandeur. An eye-witness in South Carolina wrote:

"I was suddenly awakened by the most distressing cries that ever fell on my ears. Shrieks of horror and cries for mercy I could hear from most of the negroes of the three plantations, amounting in all to about six hundred or eight hundred. While earnestly listening for the cause I heard a faint voice near the door calling my name. I arose, and, taking my sword, stood at the door. At this moment I heard the same voice still beseeching me to rise, and saying, 'O my God, the world is on fire!' I then opened the door, and it is difficult to say which excited me the most—the awfulness of the scene or the distressed cries of the negroes. Upwards of one hundred lay prostrate on the ground—some speechless and some with the bitterest cries, but with their hands raised, imploring God to save the world and them. The scene was truly awful; for never did rain fall much thicker than the meteors fell toward the earth; east, west, north, and south, it was the same."—LANGLEY *New Astronomy*, ch. 6, p. 194. (H. M. & Co., 1896.)

3381. TEST OF SCIENTIFIC THEORY—*Two Elements of Value.*—The value which every scientific theory possesses is measured by the number and importance of the objects which can be explained by it, as well as by the simplicity and universality of the causes which are employed in it as grounds of explanation. On the one hand, the greater the number and the more important the meaning of the phenomena explained by the theory, and the simpler, on the other hand, and the more general the causes which the theory assigns as explanations, the greater is its scientific value, the more safely we are guided by it, and the more strongly are we bound to adopt it. —HAECKEL *History of Creation*, vol. i, ch. 2, p. 25. (K. P. & Co., 1899.)

3382. TESTS, FUTILE, OF SPONTANEOUS GENERATION—*Death-point of Bacteria Not Yet Found—Supposed New Life a Survival of the Old.*—I have had several cases of survival [of germs] after four and five hours' boiling, some survivals after six, and one after eight hours' boiling. Thus far has experiment actually reached; but there is no valid warrant for fixing upon even eight hours as the extreme limit of vital resistance. Probably more extended researches (tho mine have been very extensive) would reveal germs more obstinate still. I

is also certain that we might begin earlier, and find germs which are destroyed by a temperature far below that of boiling water. In the presence of such facts, to speak of a death-point of bacteria and their germs would be unmeaning.—TYNDALL *Floating Matter of the Air,* essay 5, p. 307. (A., 1895.)

3383. TEXTILES OF PRIMITIVE MAN—*Early Patterns the Despair of Modern Imitators.*—The cotton-gin and power-loom are among the wonders of our age. Yet in that [primitive] day human fingers wrought the textile from first to last. They gathered the bark or wool, colored them to suit the primitive taste, spun and wove them with simple apparatus, and left upon the fabric patterns that are the despair of all modern machine-makers—patterns that are a pleasure to the eye by their infinite variety, replaced in modern fabrics by a dreary monotony that awakens pain instead of pleasure. —MASON *The Birth of Invention (Address at Centenary of American Patent System, Washington, D. C., 1891, Proceedings of the Congress,* p. 408).

3384. THEOLOGY, ACCEPTANCE OF, READY MADE—*Spiritual Parasitism.*—There are still large numbers whose only contact with religion is through theological forms. . . . If the greatest minds of the church's past, having exercised themselves profoundly upon the problems of religion, formulated as with one voice a system of doctrine, why should the humble inquirer not gratefully accept it? Why go over the ground again? Why with his dim light should he betake himself afresh to Bible study, and with so great a body of divinity already compiled presume himself to be still a seeker after truth? Does not theology give him Bible truth in reliable, convenient, and, moreover, in logical propositions? There it lies extended to the last detail in the tomes of the fathers, or abridged in a hundred modern compendiums, ready made to his hand, all cut and dry, guaranteed sound and wholesome, why not use it?

Just because it is all cut and dry. Just because it is ready made. Just because it lies there in reliable, convenient, and logical propositions. The moment you appropriate truth in such a shape you appropriate a form. You cannot cut and dry truth. You cannot accept truth ready made without it ceasing to nourish the soul as truth. You cannot live on theological forms without becoming a parasite and ceasing to be a man.—DRUMMOND *Natural Law in the Spiritual World,* essay 10, p. 323. (H. Al.)

3385. THEOLOGY, ANCIENT, OPPOSED TO SCIENCE—*Bruno Burned by Inquisition — Galileo's Recantation.*—If the neighboring stars are placed at tens and hundreds of billions of miles from us, it is at quadrillions, at quintillions of miles that most of the stars lie which are visible in the sky in telescopic fields. What suns! What splendors! Their light comes from such distances! And it is these distant suns which human pride would like to make revolve round our atom; and it was for our eyes that ancient theology declared these lights, invisible without a telescope, were created! It was because the philosophical astronomer, Giordano Bruno, asserted these distant suns to be centers of other systems that the Inquisition caused him to be burned alive at Rome before the terrified people; and it was because Galileo persisted in maintaining that our planet is subject to the sun, and that that body is itself but a star lost in infinitude, that this same Inquisition ordered him under pain of death to kneel before the Gospels (Church of Minerva at Rome, June 22, 1633) and abjure the truth which his conscience believed!—FLAMMARION *Popular Astronomy,* bk. vi, ch. 5, p. 601. (A.)

3386. THEOLOGY THE HIGHEST SCIENCE—*Would Naturally Be Last to Reach Perfection.*—Theology continues to be considered, as it has always been, a thing apart. It remained still a stupendous and splendid construction, but on lines altogether its own. Nor is theology to be blamed for this. Nature has been long in speaking; even yet its voice is low, sometimes inaudible. Science is the true defaulter, for theology had to wait patiently for its development. As the highest of the sciences, theology in the order of evolution should be the last to fall into rank. It is reserved for it to perfect the final harmony.—DRUMMOND *Natural Law in the Spiritual World,* int., p. 15. (H. Al.)

3387. THEORIES ABANDONED BY GREAT SCIENTIST—*Newton Undetermined as to Nature of Gravitation.*—At the time, . . . that Newton recognized all movements of the cosmical bodies to be the results of one and the same force, he did not, like Kant, regard gravitation as an essential property of bodies, but considered it either as the result of some higher and still unknown power, or of "the centrifugal force of æther, which fills the realms of space, and is rarer within bodies, but increases in density outward." The latter view is set forth in detail in a letter to Robert Boyle (dated February 28, 1678), which ends with the words, "I seek the cause of gravity in the æther." Eight years afterward, as we learn from a letter he wrote to Halley, Newton entirely relinquished this hypothesis of the rarer and denser ether. It is especially worthy of notice that in 1717, nine years before his death, he should have deemed it necessary expressly to state, in the short preface to the second edition of his "Optics," that he did not by any means consider gravity as an "essential property of bodies"; while Gilbert, as early as 1600, regarded magnetism as a force inherent in all matter. So undetermined was even Newton,

the profound and experienced thinker, regarding the "ultimate mechanical cause" of all motion.—HUMBOLDT *Cosmos*, vol. iii, int., p. 22. (H., 1897.)

3388. THEORIES, CONFLICTING, OF GEOLOGISTS—*How Alpine Valleys Were Formed—Fracture vs. Erosion.*—To the physical geologist the conformation of the Alps and of mountain regions generally constitutes one of the most interesting problems of the present day. To account for this conformation, two hypotheses have been advanced, which may be respectively named the hypothesis of fracture and the hypothesis of erosion. Those who adopt the former maintain that the forces by which the Alps were elevated produced fissures in the earth's crust, and that the valleys of the Alps are the tracks of these fissures. Those who hold the latter hypothesis maintain that the valleys have been cut out by the action of ice and water, the mountains themselves being the residual forms of this grand sculpture. To the erosive action here indicated must be added that due to the atmosphere (the severance and detachment of rocks by rain and frost), as affecting the forms of the more exposed and elevated peaks.—TYNDALL *Hours of Exercise in the Alps*, ch. 20, p. 219. (A., 1898.)

3389. THEORIES FRAMED IN THE IDEAL WORLD—*Their Verification in the World of Fact—The Final Test the Gift of Prophecy (2 Pet. i, 19).*—Tho the region of physical theory lies thus behind the world of senses, the verifications of theory occur in that world. Laying the theoretic conception at the root of matters, we determine by deduction what are the phenomena which must of necessity grow out of this root. If the phenomena thus deduced agree with those of the actual world, it is a presumption in favor of the theory. If, as new classes of phenomena arise, they also are found to harmonize with theoretic deduction, the presumption becomes still stronger. If, finally, the theory confers prophetic vision upon the investigator, enabling him to predict the occurrence of phenomena which have never yet been seen, and if those predictions be found on trial to be rigidly correct, the persuasion of the truth of the theory becomes overpowering. — TYNDALL *Lectures on Light*, lect. 2, p. 47. (A., 1898.)

3390. THEORIES OF CREATION—*False Alternatives of Spencer—Creator Not External, but Immanent.*—Spencer says: "The verbally intelligent suppositions respecting the origin of the universe are three: (1) It is self-existent; (2) it is self-created; (3) it is created by an external agency." On these it may be remarked that the second is scarcely even "verbally intelligent"; it seems to be a contradiction in terms. The third admits of an important modification, which was manifest to Spinoza, if not to Spencer—namely, that the Creator may—nay, must—be not merely "external," but within the universe as well. If there is a God, he must be in the universe as a pervading power, and in every part of it, and must not be shut out from his own work. This mistaken conception of God as building himself out of his own universe and acting on it by external force is both irrational and unscientific, being, for example, quite at variance with the analogy of force and life. Rightly understood, therefore, Spencer's alternatives resolve themselves into two—either the universe is self-existent, or it is the work of a self-existent Creator pervading all things with his power. —DAWSON *Facts and Fancies in Modern Science*, lect. 1, p. 29. (A. B. P. S.)

3391. THEORIES OF SLOW GROWTH—*Undulatory Theory of Light.*—Not in a moment are great theories elaborated: the facts which demand them are first called into prominence by observant minds; then, to the period of observation succeeds a period of pondering and of tentative explanation. By such efforts the human mind is gradually prepared for the final theoretic illumination. The colors of thin plates, for example, occupied the attention of the celebrated Robert Boyle. In his "Experimental History of Colors" he contends against the schools which affirmed that color was "a penetrative quality that reaches to the innermost parts of the object," adducing opposing facts. [It was not till a century later, however, that the undulatory theory of light was finally established by Thomas Young.]—TYNDALL *Lectures on Light*, lect. 2, p. 68. (A., 1898.)

3392. THEORIES OF THE HEAVENS—*Pictures Made to Illustrate—A True Map of the Skies—Preconceived Opinions Disregarded.*—It occurred to me very early in my inquiry into the great problem, and before I had fully investigated the long and noble series of researches by which Sir W. Herschel had attempted to master it, that this was a case where the mental vision must be assisted by the bodily vision. It is singular that hitherto, so far as I know (and I think little that has been done on the subject has escaped my reading), the idea of picturing the results obtained by telescopic scrutiny had been altogether overlooked. I do not here refer to pictures illustrating theories of the universe. Every student of astronomy knows that Sir W. Herschel was careful to give diagrams illustrating his successive conceptions of the structure of the universe. But such illustrations as these, tho necessary and useful, cannot throw any light on the structure of the universe, since they illustrate theories already formed, not facts on which theories are to be based. What seemed to me most desirable was that charts should be constructed on which the results of telescopic observation should be carefully mapped down without reference to any preconceived opinions, and solely with the in-

tention of interpreting as satisfactorily as possible whatever laws of stellar distribution may really exist. It appeared to me that mere lists of numbers could afford but unsatisfactory evidence on such points. —PROCTOR *Expanse of Heaven*, p. 263. (L. G. & Co., 1897.)

3393. THEORIES PERISH, FACTS REMAIN—*Planetary Motions Constant—Human Systems Progressive—Gravitation May Be Superseded.*—When . . . we come to study the history of science, the distinction between fact and theory obtrudes itself at once upon our attention. We see that, while the prominent facts of science have remained the same, its history has been marked by very frequent revolutions in its theories or systems. The courses of the planets have not changed since they were watched by the Chaldean astronomers, three thousand years ago; but how differently have their motions been explained—first by Hipparchus and Ptolemy, then by Copernicus and Kepler, and lastly by Newton and Laplace!—and, however great our faith in the law of universal gravitation, it is difficult to believe that even this grand generalization is the final result of astronomical science.—COOKE *The New Chemistry*, lect. 1, p. 1. (A., 1899.)

3394. THEORIES, TENTATIVE, OF ORIGIN OF CAVES—*Earthquakes Not the Cause—Water Alone Could Not Excavate—Truth the Outcome of Many Errors.*—It was at no very distant date pretty generally believed that caves were due to internal contortions of the crust of the earth, by which the rocks were rent asunder, leaving gaps and breaks such as we now see. But an examination of the interior of the caves soon showed that this was quite an impossible explanation, for it was found that both the floor and the roof were composed of solid rock, and that so far from there being any indication of folding and crumbling of the mass, which could account for the existence of a cavity, the rock was, in fact, unbroken both above and below, and in most cases the lie of the beds was perfectly continuous. Then, again, it was supposed that the caves had been worn by the mechanical action of running water alone, in places where a fault occurred in the rock—that is, where, from a local displacement of the beds, one portion of the series was elevated above or depressed below its normal level, thus leaving a vertical or diagonal crack, which might well be supposed to be a line of weakness. Probable as this view appears, it was, however, found that the caves did not, in fact, follow these lines, but were sometimes seen actually to be excavated across them, and yet another theory [that of erosion by carbonated water] was necessary to elucidate their origin.—DALLAS *Nature-Studies*, p. 39. (Hum., 1888.)

3395. THEORY ABANDONED—*Interior of the Sun Not a Cool, Dark Body.*—Spectrum analysis has further taught us more about the sun, by which he is brought nearer to us, as it were, than could formerly have seemed possible. You know that the sun is an enormous sphere, whose diameter is 112 times as great as that of the earth. We may consider what we see on its surface as a layer of incandescent vapor, which, to judge from the appearances of the sun-spots, has a depth of about 500 miles. This layer of vapor, which is continually radiating heat on the outside, and is certainly cooler than the inner masses of the sun, is, however, hotter than all our terrestrial flames—hotter even than the incandescent carbon-points of the electrical arc, which represent the highest temperature attainable by terrestrial means. . . . The older assumption that the sun is a dark, cool body, surrounded by a photosphere which only radiates heat and light externally, contains a physical impossibility.—HELMHOLTZ *Popular Lectures*, lect. 4, p. 157. (L. G & Co., 1898.)

3396. THEORY AND FACT — *The Tragedy of Science.*—The great tragedy of science—the slaying of a beautiful hypothesis by an ugly fact—which is so constantly being enacted under the eyes of philosophers, was played, almost immediately, for the benefit of Buffon and Needham [regarding their theory of "organic molecules," *i. e.*, of universal and indestructible molecular life]. —HUXLEY *Lay Sermons*, serm. 15, p. 356. (A., 1895.)

3397. THEORY AND PRACTICE—*Skill in Action Not Coextensive with Knowledge of Principles.*—Expertness in the performance of an art does not depend on a knowledge of its principles, and can be readily acquired without reference to them. The most expert accountants are frequently and perhaps generally those who have no knowledge of the philosophy of figures. On the other hand, a profound acquaintance with the principles of an art may exist without the ability to apply it in practise. I have known of mathematicians who were unable to perform with accuracy and despatch the processes which constitute the application of the simple rules of multiplication and addition. The same is the case with the art of composition. A most learned rhetorician is not necessarily a fluent and pleasing writer. The acquisition, therefore, of these arts should be the principal and prominent object of the primary or common school, and nothing ought to be suffered to usurp their place. . . . I may venture to say that the general substitution of instruction in the mere rationale of the rules of arithmetic without a proper drilling in the practise would produce more bankruptcies than all the changes of tariffs or fluctuations of trade.—HENRY *Thoughts on Education (Scientific Writings*, vol. i, p. 336). (Sm. Inst., 1886.)

3398. THEORY, ATOMIC, FORESHADOWED — Surely it cannot be said that Boyle [1626-1692] had not perceived that it was the province of science to concern herself not with matter, but with the changes in matter. "I am apt to think," he avers, "that men will never be able to explain the phenomena of Nature while they endeavor to deduce them only from the presence and proportions of such and such material ingredients, and consider such ingredients or elements as bodies in a state of rest; whereas, indeed, the greatest part of the affections of matter, and consequently of the phenomena of Nature, seems to depend upon the motion and contrivance of the small parts of bodies."—PARK BENJAMIN *Intellectual Rise in Electricity*, ch. 13, p. 416. (J. W., 1898.)

3399. THEORY, ATTEMPT TO SHAPE SCIENCE TO FIT—*A "Convenient Generalization" in Chemistry.*—We are afraid it must also be said—tho shown only by slight indications in his fundamental work, and coming out in full evidence only in his later writings—that M. Comte, at bottom, was not so solicitous about completeness of proof as becomes a positive philosopher, and that the unimpeachable objectivity, as he would have called it, of a conception—its exact correspondence to the realities of outward fact—was not, with him, an indispensable condition of adopting it, if it was subjectively useful, by affording facilities to the mind for grouping phenomena. This appears very curiously in his chapters on the philosophy of chemistry. He recommends, as a judicious use of "the degree of liberty left to our intelligence by the end and purpose of positive science," that we should accept as a convenient generalization the doctrine that all chemical composition is between two elements only.—MILL *Positive Philosophy of Auguste Comte*, p. 55. (H. H. & Co., 1887.)

3400. THEORY CONFIRMED BY FACT—*Neptune Found Where Gravitation Demanded.*—By it [the discovery of Neptune] the last lingering doubts as to the absolute exactness of the Newtonian law were dissipated. Recondite analytical methods received a confirmation brilliant and intelligible even to the minds of the vulgar, and emerged from the patient solitude of the study to enjoy an hour of clamorous triumph. Forever invisible to the unaided eye of man, a sister-globe to our earth was shown to circulate, in perpetual frozen exile, at thirty times its distance from the sun. Nay, the possibility was made apparent that the limits of our system were not even thus reached, but that yet profounder abysses of space might shelter obedient tho little favored members of the solar family, by future astronomers to be recognized through the sympathetic thrillings of Neptune, even as Neptune himself was recognized through the telltale deviations of Uranus.—CLERKE *History of Astronomy*, pt. i, ch. 4, p. 102. (Bl., 1893.)

3401. THEORY, FALSE, MAKES MEN BLIND TO FACTS—*Sea, Not Land, is Permanent.*—The interminable controversies to which the phenomena of the Bay of Baiæ [the rise and subsidence of the level of the Temple of Serapis] gave rise have sprung from an extreme reluctance to admit that the land, rather than the sea, is subject alternately to rise and fall. Had it been assumed that the level of the ocean was invariable, on the ground that no fluctuations have as yet been clearly established, and that, on the other hand, the continents are inconstant in their level, as has been demonstrated by the most unequivocal proofs again and again, from the time of Strabo to our own times, the appearances of the temple at Puzzuoli could never have been regarded as enigmatical. Even if contemporary accounts had not distinctly attested the upraising of the coast, this explanation should have been proposed in the first instance as the most natural, instead of being now adopted unwillingly when all others have failed.

To the strong prejudices still existing in regard to the mobility of the land, we may attribute the rarity of such discoveries as have been recently brought to light in the Bay of Baiæ. A false theory, it is well known, may render us blind to facts which are opposed to our prepossessions, or may conceal from us their true import when we behold them. But it is time that the geologist should, in some degree, overcome those first and natural impressions which induced the poets of old to select the rock as the emblem of firmness—the sea as the image of inconstancy. Our modern poet, in a more philosophical spirit, saw in the sea "the image of eternity," and has finely contrasted the fleeting existence of the successive empires which have flourished and fallen on the borders of the ocean with its own unchanged stability.

> ——— Their decay
> Has dried up realms to deserts:—not so thou,
> Unchangeable save to thy wild wave's play:
> Time writes no wrinkle on thine azure brow;
> Such as creation's dawn beheld, thou rollest now.
> —BYRON *Childe Harold*, canto iv.

—LYELL *Principles of Geology*, bk. ii, ch. 29, p. 518. (A., 1854.)

3402. THEORY MUST POINT THE WAY FOR EXPERIMENT — *Experiment Must Be the Test of Theory.*—The conviction is constantly gaining ground, that in the present more advanced state of science those only can experimentalize profitably who have a clear-sighted knowledge of theory, and know how to propound and pursue the right questions: and, on the other hand, only those can theorize with advantage who have great practise in experiments. The discovery of spectrum analysis is the most brilliant example within our recollec-

tion of such an interpenetration of theoretical knowledge and experimental skill.—HELMHOLTZ *Popular Lectures*, lect. 1, p. 19. (L. G. & Co., 1898.)

3403. THEORY OF CREATION—*Sketch of the Nebular Hypothesis.*—In their view [*i. e.*, the view of Kant and Laplace, known as "the nebular hypothesis"] our system was originally a chaotic ball of nebulous matter, of which originally, when it extended to the path of the most distant planet, many billions of cubic miles could contain scarcely a gram of mass. This ball, when it had become detached from the nebulous balls of the adjacent fixed stars, possessed a slow movement of rotation. It became condensed under the influence of the reciprocal attraction of its parts; and, in the degree in which it condensed, the rotatory motion increased, and formed it into a flat disk. From time to time masses at the circumference of this disk became detached under the influence of the increasing centrifugal force; that which became detached formed again into a rotating nebulous mass, which either simply condensed and formed a planet, or during this condensation again repelled masses from the periphery, which became satellites, or in one case, that of Saturn, remained as a coherent ring. In another case the mass which separated from the outside of the chief ball divided into many parts, detached from each other, and furnished the swarms of small planets between Mars and Jupiter.—HELMHOLTZ *Popular Lectures*, lect. 4, p. 173. (L. G. & Co., 1898.)

3404. THEORY OF "CRYSTAL SPHERES"—*The Conception of the Middle Ages—Destruction of Theory by Kepler.*—The idea of a crystalline vault of heaven was handed down to the Middle Ages by the fathers of the church, who believed the firmament to consist of from seven to ten glassy strata, incasing one another like the different coatings of an onion. This supposition still keeps its ground in some of the monasteries of Southern Europe, where I was greatly surprised to hear a venerable prelate express an opinion in reference to the fall of aerolites at Aigle, which at that time formed a subject of considerable interest, that the bodies we called meteoric stones with vitrified crusts were not portions of the fallen stone itself, but simply fragments of the crystal vault shattered by it in its fall. Kepler, from his considerations of comets which intersect the orbits of all the planets, boasted, nearly two hundred and fifty years ago, that he had destroyed the seventy-seven concentric spheres of the celebrated Girolamo Fracastoro, as well as all the more ancient retrograde epicycles.—HUMBOLDT *Cosmos*, vol. iii, p. 125. (H., 1897.)

3405. ——— ——— *The System of Pythagoras—"Music of the Spheres."*—He [Pythagoras] is said to have taught that the heavenly bodies were set in a number of crystalline spheres, in the common center of which the earth was placed. In the outer of these spheres were set the thousands of fixed stars which stud the firmament, while each of the seven planets had its own sphere. The transparency of each crystal sphere was perfect, so that the bodies set in each of the outer spheres were visible through all the inner ones. These spheres all rolled round on each other in a daily revolution, thus causing the rising and setting of the heavenly bodies. This rolling of the spheres on each other made a celestial music, the "music of the spheres," which filled the firmament, but was of too elevated a character to be heard by the ears of mortals.—NEWCOMB *Popular Astronomy*, pt. i, int., p. 3. (H., 1899.)

3406. THEORY OF DEW—*An Effect of Chilling by Radiation.*—A series of experiments, conceived and executed with admirable clearness and skill, enabled Dr. Wells to propound a theory of dew, which has stood the test of all subsequent criticism, and is now universally accepted. It is an effect of chilling by radiation. "The upper parts of the grass radiate their heat into regions of empty space, which, consequently, send no heat back in return; its lower parts, from the smallness of their conducting power, transmit little of the earth's heat to the upper parts, which, at the same time, receiving only a small quantity from the atmosphere, and none from any other lateral body, must remain colder than the air, and condense into dew its watery vapor, if this be sufficiently abundant in respect to the decreased temperature of the grass." Why the vapor itself, being a powerful radiant, is not so quickly chilled as the grass, has been already explained on the ground that the vapor has not only its own heat to discharge, but also that of the large mass of air by which it is surrounded. Dew, then, is the result of the condensation of atmospheric vapor, on substances which have been sufficiently cooled by radiation; and as bodies differ widely in their radiative powers, we may expect corresponding differences in the deposition of dew. This Wells proved to be the case. He often saw dew copiously deposited on grass and painted wood, when none could be observed on gravel walks adjacent.—TYNDALL *Heat a Mode of Motion*, lect. 17, p. 498. (A., 1900.)

3407. THEORY OF "FACULTIES" A BONDAGE—*Feeling, Desire, Impulse, and Will Combine in Free Choice.*—It is in the doctrine of feeling and will more than anywhere else that psychology still wears the fetters of the old faculty theory. . . . Thus first of all feeling was considered apart from its connection with will, and then desire was treated as a separate process, sometimes found in connection with feeling. Further, impulse was opposed to desire proper as an obscure desire, in which the subject is not

conscious of the desired object; or, perhaps, as a lower desire, referring exclusively to the needs of sense. (That is why many psychologists hold that impulses only exist among animals.) And finally these processes are still further supplemented by the postulation of will as an entirely new and independent faculty, whose function it is to choose between the various objects of desire, or in certain circumstances to act in accordance with purely intellectual motives and in opposition to impulses and desires. According to this theory, that is, will consists in the capacity for free choice. Choice in this sense presupposes the possibility of decision between various objects of desire, and even of decision against the desired object on the ground of purely rational considerations.—WUNDT *Psychology*, lect. 15, p. 224. (Son. & Co., 1896.)

3408. THEORY OF MORALITY DOES NOT SAVE—*Lower Impulses Given the Right of Way—The Limp Character.*—Men do not differ so much in their mere feelings and conceptions. Their notions of possibility and their ideals are not as far apart as might be argued from their differing fates. No class of them have better sentiments or feel more constantly the difference between the higher and the lower path in life than the hopeless failures, the sentimentalists, the drunkards, the schemers, the "dead-beats," whose life is one long contradiction between knowledge and action, and who, with full command of theory, never get to holding their limp characters erect. No one eats of the fruit of the tree of knowledge as they do; as far as moral insight goes, in comparison with them, the orderly and prosperous philistines whom they scandalize are sucking babes. And yet their moral knowledge, always there grumbling and rumbling in the background—discerning, commenting, protesting, longing, half resolving—never wholly resolves, never gets its voice out of the minor into the major key, or its speech out of the subjunctive into the imperative mood, never breaks the spell, never takes the helm into its hands. In such characters as Rousseau and Restif it would seem as if the lower motives had all the impulsive efficacy in their hands. Like trains with the right of way, they retain exclusive possession of the track. The more ideal motives exist alongside of them in profusion, but they never get switched on, and the man's conduct is no more influenced by them than an express train is influenced by a wayfarer standing by the roadside and calling to be taken aboard. They are an inert accompaniment to the end of time; and the consciousness of inward hollowness, that accrues from habitually seeing the better only to do the worse, is one of the saddest feelings one can bear with him through this vale of tears. —JAMES *Psychology*, vol. ii, ch. 26, p. 547. (H. H. & Co., 1899.)

3409. THEORY, PRECONCEIVED, RETARDS SCIENCE—*All Fossils Assigned to the Deluge—Medieval Geology.*—The theologians who now [1670] entered the field in Italy, Germany, France, and England, were innumerable; and henceforward they who refused to subscribe to the position, that all marine organic remains were proofs of the Mosaic deluge, were exposed to the imputation of disbelieving the whole of the sacred writings. Scarcely any step had been made in approximating to sound theories since the time of Fracastoro, more than a hundred years having been lost in writing down the dogma that organized fossils were mere sports of Nature. An additional period of a century and a half was now destined to be consumed in exploding the hypothesis that organized fossils had all been buried in the solid strata by Noah's flood. Never did a theoretical fallacy, in any branch of science, interfere more seriously with accurate observation and the systematic classification of facts. In recent times we may attribute our rapid progress chiefly to the careful determination of the order of succession in mineral masses, by means of their different organic contents and their regular superposition. But the old diluvialists were induced by their system to confound all the groups of strata together instead of discriminating—to refer all appearances to one cause and to one brief period, not to a variety of causes acting throughout a long succession of epochs. They saw the phenomena only as they desired to see them, sometimes misrepresenting facts, and at other times deducing false conclusions from correct data. Under the influence of such prejudices three centuries were of as little avail as a few years in our own times, when we are no longer required to propel the vessel against the force of an adverse current. —LYELL *Principles of Geology*, bk. i, ch. 3, p. 25. (A., 1854.)

3410. THEORY PROVED BY EXPERIMENT—*Science Demands the Test of Fact—Structure of Orchid Compels Bee to Gather Pollen.*—I . . . caught and placed within the labellum [of *Cypripedium pubescens*] a very small bee which seemed of about the right size. . . . The bee vainly endeavored to crawl out again the same way by which it had entered, but always fell backwards, owing to the margins being inflected. The labellum thus acts like one of those conical traps, with the edges turned inwards, which are sold to catch beetles and cockroaches in the London kitchens. It could not creep out through the slit between the folded edges of the basal part of the labellum, as the elongated, triangular, rudimentary stamen here closes the passage. Ultimately it forced its way out through one of the small orifices close to one of the anthers, and was found when caught to be smeared with the glutinous pollen. I then put the same bee back into the labellum;

and again it crawled out through one of the small orifices, always covered with pollen. I repeated the operation five times, always with the same result. I afterwards cut away the labellum, so as to examine the stigma, and found its whole surface covered with pollen. It should be noticed that an insect in making its escape must first brush past the stigma and afterwards one of the anthers, so that it cannot leave pollen on the stigma, until, being already smeared with pollen from one flower, it enters another; and thus there will be a good chance of cross-fertilization between two distinct plants.—DARWIN *Fertilization of Orchids*, ch. 8, p. 231. (A., 1898.)

3411. THEORY STRONGER THAN EVIDENCE — *Testimony Discredited — Facts Held to be Contrary to the Uniformity of Nature — The Falling of Meteorites Pronounced Impossible.*—When induced to give the matter consideration, they [early scientists] observed that all the conditions for scientific observation were violated by these bodies [meteorites], since the wonder always happened at some far-off place or at some past time, and (suspicious circumstance!) the stones only fell in the presence of ignorant and unscientific witnesses, and never when scientific men were at hand to examine the facts. That there were many worthy if ignorant men who asserted that they had seen such stones fall, seen them with their very eyes, and held them in their own hands, was accounted for by the general love of the marvelous and by the ignorance of the common mind, unlearned in the conditions of scientific observation, and unguided by the great principle of the uniformity of the laws of Nature.—LANGLEY *New Astronomy*, ch. 6, p. 175. (H. M. & Co., 1896.)

3412. THEORY, TRUE, OF THE UNIVERSE—*Its Beneficent Effect—Advance of Science Uninterrupted from Time of Copernicus.*—The scientific revolution originated by Nicolaus Copernicus has had the rare fortune (setting aside the temporary retrograde movement imparted by the hypothesis of Tycho Brahe) of advancing without interruption to its object—the discovery of the true structure of the universe. The rich abundance of accurate observations furnished by Tycho Brahe himself, the zealous opponent of the Copernican system, laid the foundation for the discovery of those eternal laws of the planetary movements which prepared imperishable renown for the name of Kepler, and which, interpreted by Newton, and proved to be theoretically and necessarily true, have been transferred into the bright and glorious domain of thought as the intellectual recognition of Nature. It has been ingeniously said, altho, perhaps, with too feeble an estimate of the free and independent spirit which created the theory of gravitation, that "Kepler wrote a code of laws, and Newton the spirit of those laws."—HUMBOLDT *Cosmos*, vol. ii, pt. ii, p. 313. (H., 1897.)

3413. THEORY VAIN BY DEATH-BED—*Practise of Medicine the Constant Test of Science.*—I consider the study of medicine to have been that training which preached more impressively and more convincingly than any other could have done the everlasting principles of all scientific work; principles which are so simple and yet are ever forgotten again; so clear and yet always hidden by a deceptive veil.

Perhaps only he can appreciate the immense importance and the fearful practical scope of the problems of medical theory who has watched the fading eye of approaching death, and witnessed the distracted grief of affection, and who has asked himself the solemn questions, Has all been done which could be done to ward off the dread event? Have all the resources and all the means which science has accumulated become exhausted? — HELMHOLTZ *Popular Lectures*, lect. 5, p. 203. (L. G. & Co., 1898.)

3414. THEORY VALUABLE FOR RETENTION OF FACTS—The great memory for facts which a Darwin or a Spencer reveal in their books is not incompatible with the possession on their part of a mind with only a middling degree of physiological retentiveness. Let a man early in life set himself the task of verifying such a theory as that of evolution, and facts will soon cluster and cling to him like grapes to their stem. Their relations to the theory will hold them fast; and the more of these the mind is able to discern the greater the erudition will become. Meanwhile the theorist may have little, if any, desultory memory. Unutilizable facts may be unnoted by him, and forgotten as soon as heard. An ignorance almost as encyclopedic as his erudition may coexist with the latter, and hide, as it were, within the interstices of its web. Those of you who have had much to do with scholars and savants will readily think of examples of the class of mind I mean.—JAMES *Talks to Teachers*, ch. 12, p. 125. (H. H. & Co., 1900.)

3415. THEORY VS. EXPERIMENT IN MEDICINE—*Love of a Sweeping Clever Stroke—A Credulous Multitude Never Wanting.*—Do not think, gentlemen, that the struggle [between theory and experiment in medicine] is at an end. As long as there are people of such astounding conceit as to imagine that they can effect, by a few clever strokes, that which man can otherwise only hope to achieve by toilsome labor, hypotheses will be started which, propounded as dogmas, at once promise to solve all riddles. And as long as there are people who believe implicitly in that which they wish to be true, so long will the hypotheses of the former find credence. Both classes

will certainly not die out, and to the latter the majority will always belong.—HELMHOLTZ *Popular Lectures*, lect. 5, p. 224. (L. G. & Co., 1898.)

3416. THICKNESS OF EARTH'S CRUST—*Theories Corrected by Advancing Science.*—The earth is known gradually to augment in temperature as we pierce it deeper, and the depth has been calculated at which all known terrestrial bodies would be in a state of fusion. Owing, however, to the enormous pressure of the superincumbent layers, the deeper strata, according to Mr. Hopkins, would require a far higher temperature to fuse them than would suffice to fuse the strata near the earth's surface. Hence he inferred that the solid crust must have a considerably greater thickness than that given by a calculation which assumes the fusing points of the superficial and the deeper strata to be the same. Mr. Hopkins, therefore, rejected the estimate of geologists that the earth could be a molten nucleus covered by a crust only 100 miles in thickness, concluding that the depth of the crust must be at least 800 miles. Sir William Thomson considers it "extremely improbable that any crust thinner than 2,000 or 2,500 miles could maintain its figure with sufficient rigidity against the tide-generating forces of sun and moon, to allow the phenomena of the ocean tides and of precession and nutation to be as they now are."—TYNDALL *Heat a Mode of Motion*, lect. 6, p. 148. (A., 1900.)

3417. "THING IN ITSELF"—*The Unconditioned Unthinkable, and also Incredible.*—In metaphysics the assertion that we can never attain to any knowledge of things "in themselves" does not mean simply that we know things only in a few relations out of many. It does not mean even that there may be and probably are a great many relations which we have not faculties enabling us to conceive. All this is quite true, and a most important truth. But the metaphysical distinction is quite different. It affirms that if we knew things in every one of the relations that affect them, we should still be no nearer than before to a knowledge of "things in themselves." . . .

Now, as the very idea of knowledge consists in the perception of relations, this affirmation is, in the purest sense of the word, nonsense—that is to say, it is a series of words which have either no meaning at all or a meaning which is self-contradictory. It belongs to the class of propositions which throw just discredit on metaphysics—mere verbal propositions, pretending to deal with conceptions which are no conceptions at all, but empty sounds. The "unconditioned," we are told, "is unthinkable"; but words which are unthinkable had better be also unspeakable, or at least unspoken. It is altogether untrue that we are compelled to believe in the existence of anything which is "unconditioned"—in matter with no qualities—in minds with no character—in a God with no attributes. Even the metaphysicians who dwell on this distinction between the relative and the unconditioned admit that it is one to which no idea can be attached. Yet, in spite of this admission, they proceed to found many inferences upon it, as if it had an intelligible meaning.—ARGYLL *Unity of Nature*, ch. 4, p. 90. (Burt.)

3418. THIRST OF ALPINE CLIMBER—*Milk a Perfect Refreshment.*—During the previous night I had been very unwell, and as I climbed the slope I suffered from intense thirst. Water seemed powerless to quench the desire for drink. We reached a chalet, and at our request a smart young Senner caught up a pail and soon returned with it full of delicious milk. The effect of the milk was astonishing. It seemed to lubricate every atom of my body, and to exhilarate with its fragrance my brain.—TYNDALL *Hours of Exercise in the Alps*, ch. 9, p. 92. (A., 1898.)

3419. ——— ——— *Snow and Ice Increase Distress.*—We had plodded on for hours soddened by the solar heat and parched with thirst. There was

Water, water everywhere,
But not a drop to drink;

for, when placed in the mouth, the liquefaction of the ice was so slow, and the loss of heat from the surrounding tissues so painful, that sucking it was worse than total abstinence. In the midst of this solid water you might die of thirst.—TYNDALL *Hours of Exercise in the Alps*, ch. 15, p. 170. (A., 1898.)

3420. THOUGHT AND FEELING HAVE NO EXTENSION—*Intense Pleasure or Pain Annuls Space and Time.*—When I am studying a brain and nerve-communications, I am engrossed with properties exclusively belonging to the object or material world. I am unable at that moment (except by very rapid transitions or alternations) to conceive a truly mental fact, my truly mental consciousness. Our mental experience, our feelings and thoughts, have no extension, no place, no form or outline, no mechanical division of parts; and we are incapable of attending to anything mental until we shut off the view of all that. Walking in the country in spring, our mind is occupied with the foliage, the bloom, and the grassy meads—all purely objective things: we are suddenly and strongly arrested by the odor of the May blossom; we give way for a moment to the sensation of sweetness; for that moment the objective regards cease; we think of nothing extended; we are in a state where extension has no footing; there is, to us, place no longer. Such states are of short duration, mere fits, glimpses; they are constantly shifted and alternated with object states, but while they last and have their full power we are in a different world; the material world is blot-

ted out, eclipsed, for the instant unthinkable. These subject moments are studied to advantage in bursts of intense pleasure or intense pain, in fits of engrossed reflection, especially reflection upon mental facts; but they are seldom sustained in purity beyond a very short interval; we are constantly returning to the object side of things —to the world whose basis is extension and place.—BAIN *Mind and Body*, ch. 6, p. 34. (Hum., 1880.)

3421. THOUGHT AND MOTION NOT COMMENSURABLE — *Chasm between Consciousness and Mechanics.*—Every one admits the entire incommensurability of feeling as such with material motion as such. "A motion became a feeling!"—no phrase that our lips can frame is so devoid of apprehensible meaning. Accordingly, even the vaguest of evolutionary enthusiasts, when deliberately comparing material with mental facts, have been as forward as any one else to emphasize the "chasm" between the inner and the outer worlds.

"Can the oscillations of a molecule," says Mr. Spencer ["Psychology," § 62], "be represented side by side with a nervous shock [he means a mental shock], and the two be recognized as one? No effort enables us to assimilate them. That a unit of feeling has nothing in common with a unit of motion becomes more than ever manifest when we bring the two into juxtaposition."

And again ["Psychology," § 272]:

"Suppose it to have become quite clear that a shock in consciousness and a molecular motion are the subjective and objective faces of the same thing: we continue utterly incapable of uniting the two, so as to conceive that reality of which they are the opposite faces."

In other words, incapable of perceiving in them any common character. So Tyndall, in that lucky paragraph ["Fragments of Science," p. 420], which has been quoted so often that every one knows it by heart:

"The passage from the physics of the brain to the corresponding facts of consciousness is unthinkable. Granted that a definite thought and a definite molecular action in the brain occur simultaneously, we do not possess the intellectual organ, nor apparently any rudiment of the organ, which would enable us to pass, by a process of reasoning, from one to the other."

—JAMES *Psychology*, vol. i, ch. 6, p. 146. (H. H. & Co., 1899.)

3422. THOUGHT, ENLARGEMENT OF, BY VOLUNTARY STUDY—It is . . . by the use of the power which every man possesses of enlarging as well as improving his fabric of thought, by applying himself to the acquirement of new knowledge, that he gains a vastly increased capacity for the reception of a nobler and grander order of beliefs, such as he would have previously thought it impossible that he could ever come to possess.—CARPENTER *Nature and Man*, lect. 7, p. 234. (A., 1889.)

3423. THOUGHT, HUMAN, GROWS AROUND A FEW GREAT THINKERS—The thoughts of men seem rather to be comparable to the leaves, flowers, and fruit upon the innumerable branches of a few great stems, fed by commingled and hidden roots. These stems bear the names of the half a dozen men endowed with intellects of heroic force and clearness, to whom we are led, at whatever point of the world of thought the attempt to trace its history commences; just as certainly as the following up the small twigs of a tree to the branchlets which bear them, and tracing the branchlets to their supporting branches, brings us, sooner or later, to the bole.—HUXLEY *Lay Sermons*, serm. 14, p. 320. (G. P. P., 1899.)

3424. THOUGHT, ITS POWER IN MAN—The superiority of man over animals, of the scholar over the barbarian, depends upon thinking; sensation, feeling, perception, on the contrary, he shares with his lower fellow creatures, and in acuteness of the senses many of these are even superior to him. That man strives to develop his thinking faculty to the utmost is a problem on the solution of which the feeling of his own dignity as well as of his own practical power depends.—HELMHOLTZ *Popular Lectures*, lect. 5, p. 206. (L. G. & Co., 1898.)

3425. THOUGHT, NEW, HOW MADE—We must not forget that everything new that can possibly be thought is nothing more than either a combination of particulars which had previously been separate, or a separation of particulars which had been combined. As thinking cannot be accomplished without feeling and perceptions, so it is with willing.—SCHWARZ *Psychologie des Willens (a Lecture)*. (Translated for *Scientific Side-Lights.)*

3426. THOUGHT, RAPIDITY OF, IN GREAT MINDS—When two minds of a high order, interested in kindred subjects, come together, their conversation is chiefly remarkable for the summariness of its allusions and the rapidity of its transitions. Before one of them is half through a sentence the other knows his meaning and replies. Such genial play with such massive materials, such an easy flashing of light over far perspectives, such careless indifference to the dust and apparatus that ordinarily surround the subject and seem to pertain to its essence, make these conversations seem true feasts for gods to a listener who is educated enough to follow them at all.—JAMES *Psychology*, vol. ii, ch. 22, p. 370. (H. H. & Co., 1899.)

3427. THOUGHTLESSNESS UNWARNED BY OTHERS' FATE—*Bees Perishing in Sweets.*—The following scene [says Sir John Lubbock], one which most of us have witnessed, is incompatible surely with much intelligence. The sad fate of their unfortunate companions does not in the least deter others who approach the tempting lure from madly alighting on the bodies of the dying and dead, to share the same miserable end. No one can understand the extent of their infatuation until he has seen a confectioner's shop assailed by myriads of hungry bees. I have seen thousands strained out from the sirup in which they

had perished; thousands more alighting even upon the boiling sweets, the floor covered and windows darkened with bees, some crawling, others flying, and others still so completely besmeared as to be able neither to crawl nor fly, not one in ten able to carry home its ill-gotten spoils, and yet the air filled with new hosts of thoughtless comers. —ROMANES *Animal Intelligence*, ch. 4, p. 184. (A., 1899.)

3428. THUNDER-STORM THE RELEASE OF STORED ENERGY—All of the phenomena of a thunder-storm, hail-storm, or tornado, with their terrific manifestations in the form of thunder, lightning, wind, and rain, are simply the result of a sudden releasing of the stored energy in the myriads of moisture spherules that were placed there by the power of the sun when they were silently and invisibly wrested from the surface of the water, or from condensed moisture globules floating in the air.—ELISHA GRAY *Nature's Miracles*, vol. ii, ch. 2, p. 20. (F. H. & H., 1900.)

3429. TIME, ANCIENT METHODS OF MEASURING—*Difficulties Overcome by Ancient Astronomers.*—During many centuries time was only measured by sun-dials and water-clocks, or clepsydras. Water, running out regularly from a reservoir, is received in a vase which shows every hour. A float placed upon the liquid carries a little figure of a boy, which rises regularly and points to the hours. The ancient astronomers of China, Asia, Chaldea, and Greece measured in this way the hours of the night, the transits of stars across the meridian, and the duration of eclipses.—FLAMMARION *Popular Astronomy*, bk. ii, ch. 2, p. 19. (A.)

3430. TIME, ELEMENT OF, IN BACTERIAL ANALYSIS—*Rapid Multiplication of Bacteria May Defeat Experiment.*—When the sample has been duly collected, sealed, and a label affixed bearing the date, time, and conditions of collection and full address, it should be transmitted with the least possible delay to the laboratory. Frequently it is desirable to pack the bottles in a small ice case for transit. On receipt of such a sample of water the examination must be immediately preceeded with, in order to avoid, as far as possible, the fallacies arising from the rapid multiplication of germs. Even in almost pure water, at the ordinary temperature of a room, Frankland found organisms multiplied as follows:

HOURS.	NO. OF GERMS PER C. C.
0	1,073
6	6,028
24	7,262
48	48,100

Another series of observations revealed the same sort of rapid increase of bacteria. On the date of collection the micro-organisms per c. c. in a deep-well water (in April) were seven. After one day's standing at room temperature the number had reached twenty-one per c. c. After three days under the same conditions it was 495,000 per c. c. At blood-heat the increase would, of course, be much greater, as a higher temperature is more favorable to multiplication.—NEWMAN *Bacteria*, ch. 2, p. 38. (G. P. P., 1899.)

3431. TIME, EVOLUTION GIVES NEW PERSPECTIVE OF—*Reveals the Unity of Nature.*—Evolution has done for time what astronomy has done for space. As sublime to the reason as the science of the stars, as overpowering to the imagination, it has thrown the universe into a fresh perspective, and given the human mind a new dimension. Evolution involves not so much a change of opinion as a change in man's whole view of the world and of life. It is not the statement of a mathematical proposition which men are called upon to declare true or false. It is a method of looking upon Nature. Science for centuries devoted itself to the cataloguing of facts and the discovery of laws. Each worker toiled in his own little place—the geologist in his quarry, the botanist in his garden, the biologist in his laboratory, the astronomer in his observatory, the historian in his library, the archeologist in his museum. Suddenly these workers looked up; they spoke to one another; they had each discovered a law; they whispered its name. It was "evolution." Henceforth their work was one, science was one, the world was one, and mind, which discovered the oneness, was one.—DRUMMOND *Ascent of Man*, int., p. 8. (J. P., 1900.)

3432. TIME, GEOLOGIC—*A Thousand Feet of Chalk Long in Depositing.*—The chalk [of the English cliffs] is in places more than a thousand feet thick. I think you will agree with me that it must have taken some time for the skeletons of animalcules of a hundredth of an inch in diameter to heap up such a mass as that. I have said that throughout the thickness of the chalk the remains of other animals are scattered. These remains are often in the most exquisite state of preservation. The valves of the shellfishes are commonly adherent; the long spines of some of the sea-urchins, which would be detached by the smallest jar, often remain in their places. In a word, it is certain that these animals have lived and died when the place which they now occupy was the surface of as much of the chalk as had then been deposited; and that each has been covered up by the layer of globigerina-mud, upon which the creatures embedded a little higher up have, in like manner, lived and died. But some of these remains prove the existence of reptiles of vast size in the chalk sea. These lived their time, and had their ancestors and descendants, which assuredly implies time, reptiles being of slow growth. . . . Thus, not only is it certain that the chalk is the

mud of an ancient sea-bottom, but it is no less certain that the chalk sea existed during an extremely long period, tho we may not be prepared to give a precise estimate of the length of that period in years.—HUXLEY *Lay Sermons*, serm. 9, p. 189. (G. P. P., 1899.)

3433. TIME, IMMEASURABLE LAPSE OF—*Ages Required to Build Chalk Cliffs.*—The chalk . . . now seen stretching for thousands of miles over different parts of Europe has become visible to us by the effect, not of one, but of many distinct series of subterranean movements. Time has been required, and a succession of geological periods, to raise it above the waves in so many regions.—LYELL *Principles of Geology*, bk. i, ch. 10, p. 159. (A., 1854.)

3434. TIME, INCREASING APPRECIATION OF—*Our Indebtedness to Ages of Thought and Observation.*—When we picture to ourselves the virtuosity with which every schoolchild is capable in our day of measuring off and dividing up his time, and how among our ordinary citizens the more many-sided their life becomes in all directions, the more it is based upon an ever-increasingly exact appropriation of time, and that our modern great means of transportation, the railroads and telegraphs, scarcely reckon otherwise than according to minutes, indicating thereby the exactitude of their division of time, then it becomes difficult to transport our thoughts back to that period when neither the fortunate nor the unfortunate had his hour. And yet we still remember yonder blessed childhood in which we, too, without regard for time, measured off our entire career according to nothing but days and nights, and the great pleasures afforded by the festivals of the year. And we still find byways, remote from intercourse with great cities, where a countryman will have no other measure of time at his disposal than the clock on the church tower of his hamlet, and must regulate his hours of labor by the course of the sun, the moon, or the stars. Solitary shepherds are still to be met on the heath who, in classic fashion, measure time by the foot-lengths of their own shadows. But who ever thinks, as he glances at his watch or at a calendar condensed into a few pages, of the thousands of years of the most zealous astronomical observations required to furnish both of these as we have them in our day? Who ever considers that this calendar, frequently coming to us in such unpretentious garb, represents one of the greatest achievements of human research and effort?—WITTICH *Die Schnelligkeit unseres Empfindens und Wollens (a Lecture)*, p. 6. (Translated for *Scientific Side-Lights.*)

3435. TIME, LAPSE OF, MADE SENSIBLE BY DWELLING ON IT—*Preoccupation Seems to Shorten.*—Our estimate of time as it passes is commonly said to depend on the amount of consciousness which we are giving to the fact of its transition. Thus, when the mind is unoccupied and suffering from ennui, we feel time to move sluggishly. On the other hand, interesting employment, by diverting the thoughts from time, makes it appear to movè at a more rapid pace. This fact is shown in the common expressions which we employ, such as "to kill time," and the German *Langeweile.* Similarly, it is said that when we are eagerly anticipating an event, as the arrival of a friend, the mere fact of dwelling on the interval makes it appear to swell out. This view is correct in the main.—SULLY *Illusions*, ch. 10, p. 250. (A., 1897.)

3436. TIME, MAN'S FIRST MEASURE OF—*Months and Weeks Determined by the Moon.*—It was these phases and aspects of the moon which formerly gave birth to the custom of measuring time by months, and by weeks of seven days, on account of the return of the moon's phases in a month, and because the moon appears about every seven days, so to say, under a new form. Such was the first measure of time; there was not in the sky any signal of which the differences, the alternations, and the epochs were more remarkable. Families met together at a time fixed by some lunar phase.—FLAMMARION *Popular Astronomy*, bk. ii, ch. 2, p. 100. (A.)

3437. TIME OCCUPIED BY SENSATION AND VOLITION—*Illustration of Whale Wounded in the Tail.*—The time occupied by a sensation and subsequent volition has been measured in circumstances where there were no conflicting impulses. This is done by ascertaining the time elapsing between the sensation of a signal and the answering by the hand. A comparison is made between two situations; one where the person is prepared beforehand, by knowing where he is to be affected and what part is to move, in which case the attention is turned upon the proper points. The other situation is where a person does not know which part is to be struck, and which part is to be moved; in this last case he has to exercise an active judgment or consideration, and the difference of time is about the $\frac{1}{14}$th of a second. Two persons are separated by a screen; one is to utter a syllable and the other to repeat it as soon as possible. If the syllable has been agreed upon, the interval of repetition occupies from one-sixth to one-fourth of a second; if it is not agreed upon, the interval is one-twelfth of a second more. The example is put by M. Du Bois Raymond of a whale, ninety feet long, struck in the tail by a harpoon; one second would be occupied in transmitting the impression to the brain; a fraction of a second, say one-tenth, in traversing the brain; a full second in returning the motor impulse, so that the boat would have upward of two seconds for escaping the danger.—BAIN *Mind and Body*, ch. 3, p. 10. (Hum., 1880.)

3438. TIME, THE BEGINNING OR END OF, INCONCEIVABLE—We are altogether unable to conceive time as commencing; . . . we are conscious to ourselves of nothing more clearly than that it would be equally possible to think without thought as to construe to the mind an absolute commencement or an absolute termination of time. . . . Goad imagination to the utmost, it still sinks paralyzed within the bounds of time, and time survives as the condition of the thought itself in which we annihilate the universe.—HAMILTON *Metaphysics*, lect. 38, p. 529. (G. & L., 1859.)

3439. TIME WORKS VAST RESULTS WITH TRIFLING FORCE—*Crevasses of Glacier.*—[Upon the glacier] an explosion is heard. . . . The sound is repeated, several shots being fired in quick succession. . . . After an hour's strict search we discover the cause of the reports. They announce the birth of a crevasse. Through a pool upon the glacier we notice air-bubbles ascending, and find the bottom of the pool crossed by a narrow crack, from which the bubbles issue. Right and left from this pool we trace the young fissure through long distances. It is sometimes almost too feeble to be seen, and at no place is it wide enough to admit a knife-blade. . . . The great and gaping chasms on and above the ice-falls of the Géant and the Talèfre begin as narrow cracks, which open gradually to crevasses. We are thus taught in an instructive and impressive way that appearances suggestive of very violent action may really be produced by processes so slow as to require refined observations to detect them. In the production of natural phenomena two things always come into play, the intensity of the acting force and the time during which it acts. Make the intensity great and the time small, and you have sudden convulsion; but precisely the same apparent effect may be produced by making the intensity small and the time great.—TYNDALL *Forms of Water*, p. 98. (A., 1899.)

3440. TIME-KEEPING IN SLEEP—*Waking at a Specified Hour—Power Varies in Different Persons—Unconscious Chronometry.*—There are many individuals who have the power of determining, at the time of going to rest, the hour at which they shall awake, and who arouse themselves at the precise time fixed upon—not from the restless sleep which such a determination would ordinarily induce (the writer, for example, would be prevented by it from obtaining an hour of continuous repose through the whole night), but from a slumber that remains unbroken until the appointed time arrives. This fact . . . seems to point to a kind of *unconscious chronometry*, which is in some way connected with the sequence of the organic functions. . . . The whole series of such phenomena has a peculiar interest, in connection with the pretensions advanced by mesmerizers to exercise a special control over the "subjects" of their manipulations.—CARPENTER *Mental Physiology*, bk. ii, ch. 15, p. 583. (A., 1900.)

3441. TIMIDITY TAUGHT YOUNG BIRDS BY ELDERS—During the past summer, while living near Kew Gardens, I watched the sparrows a great deal, and fed forty or fifty of them every day from a back window. The bread and seed were thrown on to a low roof just outside the window, and I noticed that the young birds when first able to fly were always brought by the parents to this feeding-place, and that after two or three visits they would begin to come of their own accord. At such times they would venture quite close to me, showing as little suspicion as young chickens. The adults, however, altho so much less shy than birds of other species, were extremely suspicious, snatching up the bread and flying away; or, if they remained, hopping about in a startled manner, craning their necks to view me, and making so many gestures and motions, and little chirps of alarm, that presently the young would become infected with fear. The lesson was taught them in a surprisingly short time; their suspicion was seen to increase day by day, and about a week later they were scarcely to be distinguished in behavior from the adults. It is plain that, with these little birds, fear of man is an associate feeling, and that, unless it had been taught them, his presence would trouble them as little as does that of horse, sheep, or cow.—HUDSON *Naturalist in La Plata*, ch. 5, p. 84. (C. & H., 1895.)

3442. TOMBSTONES OF ANCIENT ANIMALS—*Limestone Largely Composed of Sea-shells.*—Limestone strata in the crust of the earth are found in all the periods of the earth's formation. All forms of sea-shells that were once the homes of animal life are constructed of this compound; and in the later formations of limestone, in the Secondary and Tertiary periods, we find this rock to be made up almost entirely of marine shells, some of them microscopic in size. The earlier or older formations of limestone that are found deeper down in the earth's crust are less mingled with these marine shells. This comes from the fact that the first deposition of limestone strata occurred before the later forms of sea life had developed. Whatever signs of life are found in these lower stratifications are of the very lowest order. It is not to be understood that animal life is a necessary factor in the formation of limestone, but it has been an incidental feature which no doubt has been the chief means of gathering up from the water this compound and precipitating it into the great limestone strata that are everywhere found.—ELISHA GRAY *Nature's Miracles*, vol. i, ch. 2, p. 13. (F. H. & H., 1900.)

3443. TOOLS, ANCIENT INDIAN—*Provided with Carefully Wrought Handles—The Grip a Matter of Thought and Care.*—The ingenuity of the American mechanic in hafting his tools and bringing them to their work cannot be overlooked. In this study the archeologist must learn of the ethnologist. The study of hafting must take into consideration the grip and the attachment. The grip of the implement may be a part of the object itself, or it may be a separate piece fastened on. In the Eskimo scrapers, women's knives, men's knives, throwing-sticks, and harpoons, the greatest care was taken to have the grip so fit the hand and fingers that the greatest force and dexterity could be used in operating them.—MASON *Aboriginal American Mechanics (Memoirs of the International Congress of Anthropology,* p. 74). (Sch. P. C.)

3444. TOOLS AND WEAPONS OF PRIMITIVE MAN — *Alike in Europe and America.*—The simple weapons of bone and stone found in America closely resemble those which occur in other countries. The flakes, hatchets, axes, arrow-heads, and bone implements are, for instance, very similar to those which occur in the Swiss lakes, if only we make allowance for the differences of material. . . . [There are many] simple forms, which may almost be said to be ubiquitous.—AVEBURY *Prehistoric Times,* ch. 8, p. 237. (A., 1900.)

3445. TOOLS FITTED TO ENVIRONMENT—*Habitat Determines Material and Uses.*—The tool of the artisan is fitted to the hand; but to the scrutinizing glance of the student it is just as nicely fitted to its environment, to the work which it has to perform, to the grade of industrial education which the owner has reached, to the genius of his people, and even to their language and mythology. The director of a large museum, on examining an implement new to him, is quite as likely to fix his attention upon the region, or the work to be done, or the standing of the owner, as upon his blood or nationality. The continent of America was largely the director of the arts of the aborigines.—MASON *Aboriginal American Mechanics (Memoirs of the International Congress of Anthropology,* p. 70). (Sch. P. C.)

3446. TOUCH, SENSE OF, IN WORMS—*Shape of Objects Discovered.*—If worms are able to judge, either before drawing or after having drawn an object close to the mouths of their burrows, how best to drag it in, they must acquire some notion of its general shape. This they probably acquire by touching it in many places with the anterior extremity of their bodies, which serves as a tactile organ. It may be well to remember how perfect the sense of touch becomes in a man when born blind and deaf, as are worms. If worms have the power of acquiring some notion, however rude, of the shape of an object and of their burrows, as seems to be the case, they deserve to be called intelligent; for they then act in nearly the same manner as would a man under similar circumstances.—DARWIN *Formation of Vegetable Mould,* ch. 2, p. 28. (Hum., 1887.)

3447. TOWERS, SPIRES, AND PINNACLES OF ICE—*Nature's Architecture.*—When a glacier descends a precipice it may become broken and fall in detached blocks, thus forming veritable ice cascades; but the fragments unite again at the base of the cliffs and become reconsolidated, and the ice flows on as a continuous stream. At other times the descent is completely covered with ice so shattered as to be impassable, and presents all degrees of diversity between ice cascades and ice rapids. The places of steep descent in the floor of a névé frequently lead to the breaking of the snow and ice into cubical blocks of all dimensions up to hundreds of feet in diameter, which bear a striking resemblance to towers and other architectural forms, and add most attractive features to the scenery of glacier-covered regions. During night marches on the glaciers of Alaska, the writer could scarcely put aside the idea that these shadowy forms, partially illuminated by the northern twilight, were in reality the ruins of marble temples. In the lower portions of glaciers, where the ice is more solid and where surface melting is more rapid, the steep descents are marked by spires and pinnacles having extremely rugged and angular forms, separated by profound crevasses.—RUSSELL *Glaciers of North America,* int.. p. 10. (G. & Co., 1897.)

3448. TRACK OF VANISHED GLACIER—*Rocks Polished as by Lapidary.*—Rock surfaces that have been subjected to the grinding of an ice sheet, or crossed by even a small Alpine glacier, are frequently found to be worn and the angles and prominences rounded and planed away. All weathered and oxidized portions of the preglacial surface are removed, and the fresh hard rock exhibits a polish approaching that given by marble-workers to finished monuments. The hardest and finest-grained rocks receive the most brilliant polish. Limestone, granite, and quartzite, especially, are frequently so highly burnished that they glitter in the sunlight with dazzling brilliancy. On such surfaces there are usually scratches and grooves, frequently in long, parallel lines, which show the direction in which the ice moved over them. These markings vary in size from delicate, hairlike lines, such as might be made by a crystal point, to heavy grooves and gouges, a foot and sometimes several feet deep, which frequently run in one general direction for many yards and even several rods, and indicate by their straightness and evenness that the engine which made them was one of great power

and moved steadily in a continuous direction.—RUSSELL *Glaciers of North America*, int., p. 20. (G. & Co., 1897.)

3449. TRACTS, DEFINITE, IN BRAIN, FOR SPECIAL SERVICE—*Loss of the Power of Speech and of Writing—Other Faculties May Remain Unimpaired.*—Victims of motor aphasia generally have other disorders. One which interests us in this connection has been called *agraphia:* they have lost the power to write. They can read writing and understand it; but either cannot use the pen at all or make egregious mistakes with it. . . . The symptom may exist when there is little or no disability in the hand for other uses. If it does not get well, the patient usually . . . learns to write with his left hand. In other cases . . . the patient can write both spontaneously and at dictation, but cannot read even what he has himself written! All these phenomena are now quite clearly explained by separate brain-centers for the various feelings and movements, and tracts for associating these together.—JAMES *Psychology*, vol. i, ch. 2, p. 40. (H. H. & Co., 1899.)

3450. TRADE, PRIMITIVE, EVIDENCES OF—*Stone and Metal Bartered over Thousands of Miles.*—Till 1884 no European locality of jade or nephrite was known, and tho it has now been discovered in Silesia, and described by Traube, yet, as he points out, the European implements do not belong to the same variety, and were not therefore derived from that locality . . . ; they must therefore have passed from tribe to tribe by a sort of barter. . . .

Other facts of a similar nature are on record. Thus Messrs. Squier and Davis tell us that in the tumuli of the Mississippi Valley we find "side by side, in the same mounds, native copper from Lake Superior, mica from the Alleghanies, shells from the Gulf, and obsidian (perhaps porphyry) from Mexico." Fair representations of the seacow or manatee are found a thousand miles from the shores inhabited by that animal, and shells of the large tropical *Pyrula perversa* are met with in the tumuli round the great lakes, two thousand miles from home. —AVEBURY *Prehistoric Times*, ch. 4, p. 76. (A., 1900.)

3451. TRADITION OFTEN A TRUTHFUL MEMORIAL — *Chief's Stone Seat Found as Related—A Treasured Staff of Office.*—There are still peoples left whose whole history is the tradition of their ancestors. Thus the South Sea Islanders, who till quite lately had no writing, were intelligent barbarians, much given to handing down recollections of bygone days, and in one or two cases, which it has been possible to test among them, it seems as tho memory may really keep a historical record long and correctly. It is related by Mr. Whitmee, the missionary, that in the island of Rotuma there was a very old tree, under which, according to tradition, the stone seat of a famous chief had been buried; this tree was lately blown down, and, sure enough, there was a stone seat under its roots, which must have been out of sight for centuries. In the Ellice group, the natives declared that their ancestors came from a valley in the distant island of Samoa generations before, and they preserved an old worm-eaten staff, pieced to hold it together, which in their assemblies the orator held in his hand as the sign of having the right to speak; this staff was lately taken to Samoa, and proved to be made of wood that grew there, while the people of the valley in question had a tradition of a great party going out to sea exploring, who never came back.—TYLOR *Anthropology*, ch. 15, p. 374. (A., 1899.)

3452. TRADITION, PERUVIAN, OF DELUGE—*Parallel to Story of Genesis.*—All authentic accounts cease when we ascend to the era of the conquest of Peru by the Spaniards. The ancient Peruvians, altho far removed from barbarism, were without written annals, and therefore unable to preserve a distinct recollection of a long series of natural events. They had, however, according to Antonio de Herrera, who, in the beginning of the seventeenth century, investigated their antiquities, a tradition, "that many years before the reign of the Incas, at a time when the country was very populous, there happened a great flood; the sea breaking out beyond its bounds, so that the land was covered with water and all the people perished. To this the Guacas, inhabiting the vale of Xausca, and the natives of Chiquito, in the province of Callao, add that some persons remained in the hollows and caves of the highest mountains, who again peopled the land. Others of the mountain people affirm that all perished in the deluge, only six persons being saved on a float, from whom descended all the inhabitants of that country."—LYELL *Principles of Geology*, bk. ii, ch. 29, p. 502. (A., 1854.)

3453. TRADITION UNTRUSTWORTHY—*Tasman and De Soto Forgotten in Lands They Discovered.*—Tradition [will not] supply the place of history. At best it is untrustworthy and short lived. Thus in 1770 the New Zealanders had no recollection of Tasman's visit. Yet this took place in 1643, less than 130 years before, and must have been to them an event of the greatest possible importance and interest. In the same way the North-American Indians soon lost all tradition of De Soto's expedition, altho "by its striking incidents it was so well suited to impress the Indian mind."—AVEBURY *Prehistoric Times*, ch. 13, p. 404. (A., 1900.)

3454. TRADITIONS OF ANCIENT DELUGES—*China's Flood Perhaps a Local Inundation.*—The great flood of the Chinese, which their traditions carry back to the

period of Yaou, something more than 2,000 years before our era, has been identified by some persons with the universal deluge described in the Old Testament; but according to Mr. Davis. who accompanied two of our embassies to China, and who has carefully examined their written accounts, the Chinese cataclysm is therein described as interrupting the business of agriculture, rather than as involving a general destruction of the human race. The great Yu was celebrated for having "opened nine channels to draw off the waters," which "covered the low hills and bathed the foot of the highest mountains." Mr. Davis suggests that a great derangement of waters of the Yellow River, one of the largest in the world, might even now cause the flood of Yaou to be repeated, and lay the most fertile and populous plains of China under water. In modern times the bursting of the banks of an artificial canal, into which a portion of the Yellow River has been turned, has repeatedly given rise to the most dreadful accidents, and is a source of perpetual anxiety to the government. It is easy, therefore, to imagine how much greater may have been the inundation if this valley was ever convulsed by a violent earthquake.—LYELL *Principles of Geology*, bk. i, ch. 2, p. 7. (A., 1854.)

3455. TRAINING, SCIENTIFIC—*Its Educational Value.*—I have already expressed a favorable opinion of the old classical methods of mind-training, but that opinion does not exclude the idea of other methods which may be equally as valuable. Of one thing we may be quite certain, and that is that in the habits of careful observation and recording, which are necessary to the study of any science, the perceptive faculties of the mind receive a training which cannot be regarded as inferior to that secured by any other method. In considering the data which are obtained by perception, the reflective faculties also obtain a training of the highest value. Teachers of science, therefore, must not be regarded wholly from a technical point of view, but must be entitled to a proper recognition from the pedagogic side.—WILEY *Relations of Chemistry to Industrial Progress (Address at Purdue University, Lafayette, Ind., 1896*, p. 50).

3456. TRANSCENDENTALISM IN SCIENCE — *Matter Analyzed into Force.* — There are eddies in every stream—eddies where rubbish will collect and circle for a time. But the ultimate bearing of scientific truth cannot be mistaken. Nothing is more remarkable in the present state of physical research than what may be called the transcendental character of its results. And what is transcendentalism but the tendency to trace up all things to the relation in which they stand to abstract ideas? And what is this but to bring all physical phenomena nearer and nearer into relation with the phenomena of mind? The old speculations of philosophy which cut the ground from materialism by showing how little we know of matter are now being daily reenforced by the subtle analysis of the physiologist, the chemist, and the electrician. Under that analysis matter dissolves and disappears, surviving only as the phenomena of force; which again is seen converging along all its lines to some common center—"sloping through darkness up to God."—ARGYLL *Reign of Law*, ch. 2, p. 70. (Burt.)

3457. TRANSFER OF THOUGHT IMPOSSIBLE—*Signs Awaken Corresponding Idea—No Resemblance between Thought and Sign.*—Consider, with Professor Bowne, what happens when two people converse together and know each other's mind.

"No thoughts leave the mind of one and cross into the mind of the other. When we speak of an exchange of thought, even the crudest mind knows that this is a mere figure of speech. . . . To perceive another's thought we must construct his thought within ourselves; . . . this thought is our own and is strictly original with us. At the same time we owe it to the other; and if it had not originated with him, it would probably not have originated with us. But what has the other done? . . . This: by an entirely mysterious world-order, the speaker is enabled to produce a series of signs which are totally unlike [the] thought, but which, by virtue of the same mysterious order, act as a series of incitements upon the hearer, so that he constructs within himself the corresponding mental state. The act of the speaker consists in availing himself of the proper incitements. The act of the hearer is immediately only the reaction of the soul against the incitement. . . . All communion between finite minds is of this sort." —JAMES *Psychology*, vol. i, ch. 8, p. 219. (H. H. & Co., 1899.)

3458. TRANSFIGURATION OF PHENOMENA BY LAW—*Need of Law in Spiritual World.*—I confess that even when in the first dim vision the organizing hand of law moved among the unordered truths of my spiritual world, poor and scantily furnished as it was, there seemed to come over it the beauty of a transfiguration. The change was as great as from the old chaotic world of Pythagoras to the symmetrical and harmonious universe of Newton. My spiritual world before was a chaos of facts; my theology a Pythagorean system trying to make the best of phenomena apart from the idea of law. I make no charge against theology in general. I speak of my own. And I say that I saw it to be in many essential respects centuries behind every department of science I knew. It was the one region still unpossessed by law. I saw then why men of science distrust theology; why those who have learned to look upon law as au-

thority grow cold to it—it was the great exception.—DRUMMOND *Natural Law in the Spiritual World*, pref., p. 9. (H. Al.)

3459. TRANSFORMATION BY CHANGED CONDITIONS—*Worker Changed to Queen—Potentiality To Be Accounted for.*—The most remarkable example with which I am acquainted, of the effect of physical conditions in modifying the developmental process, is that which is seen in the economy of the hive-bee. It is well known that whenever, from any cause, a community wants a queen, a worker grub at an early stage is selected; a "royal cell" is constructed round it, several ordinary cells being demolished for the purpose, and their contained grubs killed; the selected grub is fed with "royal jelly" instead of with "bee-bread"; and (it seems probable) a higher temperature is maintained by the incessant activity of the bees which cluster about the royal nursery. In due time a perfect "queen" comes forth, differing from the "worker" not merely in the completeness of its reproductive apparatus, but in the conformation of its jaws and antennæ, the absence of "pollen-baskets" on the thighs, and yet more remarkably in its instincts. Now it is obviously no explanation of this extraordinary transformation to say that every worker grub is a "potential" queen, because the attributing this "potentiality" to it is only another way of expressing the fact that it can be so transformed. The existence of the "potentiality," and of the wonderful instinct that leads the worker bees to act upon it, are not less evidences of "design," because physical agencies are needed to call them into exercise.—CARPENTER *Nature and Man*, lect. 15, p. 440. (A., 1889.)

3460. TRANSFORMATION, GRADUAL, FROM ANCIENT TO MODERN TYPE—*Crocodile the Heir of a Long Succession.*—The crocodiles are animals which, as a group, have a very vast antiquity. They abounded ages before the chalk was deposited; they throng the rivers in warm climates at the present day. There is a difference in the form of the joints of the backbone, and in some minor particulars, between the crocodiles of the present epoch and those which lived before the chalk. . . . But each epoch has had its peculiar crocodiles, tho all, since the chalk, have belonged to the modern type, and differ simply in their proportions, and in such structural particulars as are discernible only to trained eyes. How is the existence of this long succession of different species of crocodiles to be accounted for? Only two suppositions seem to be open to us—either each species of crocodile has been specially created, or it has arisen out of some preexisting form by the operation of natural causes. Choose your hypothesis; I have chosen mine. I can find no warranty for believing in the distinct creation of a score of successive species of crocodiles in the course of countless ages of time. Science gives no countenance to such a wild fancy; nor can even the perverse ingenuity of a commentator pretend to discover this sense, in the simple words in which the writer of Genesis records the proceedings of the fifth and sixth days of the creation. On the other hand, I see no good reason for doubting the necessary alternative, that all these varied species have been evolved from preexisting crocodilian forms, by the operation of causes as completely a part of the common order of Nature as those which have effected the changes of the inorganic world.—HUXLEY *Lay Sermons*, serm. 9, p. 200. (G. P. P., 1899.)

3461. TRANSFORMATION OF ENGLAND THROUGH THE DISCOVERY OF COAL—*Possible Effect of Its Exhaustion.*—Three hundred years ago the sun, looking down on the England of our forefathers, saw a fair land of green woods and quiet waters, a land unvexed with noisier machinery than the spinning-wheel or the needles of the "free maids that weave their threads with bones." Because of the coal which has been dug from its soil he sees it now soot-blackened, furrowed with railway-cuttings, covered with noisy manufactories, filled with grimy operatives, while the island shakes with the throb of coal-driven engines, and its once quiet waters are churned by the wheels of steamships. Many generations of the lives of men have passed to make the England of Elizabeth into the England of Victoria; but what a moment this time is, compared with the vast lapse of ages during which the coal was being stored! What a moment in the life of the "all-beholding sun," who in a few hundred years—his gift exhausted and the last furnace fire out—may send his beams through rents in the ivy-grown walls of deserted factories, upon silent engines brown with rust, while the mill-hand has gone to other lands, the rivers are clean again, the harbors show only white sails, and England's "black country" is green once more! To America, too, such a time may come, tho at a greatly longer distance.—LANGLEY *New Astronomy*, ch. 4, p. 115. (H. M. & Co., 1896.)

3462. TRANSFORMATION OF PAST INTO PRESENT—*The Past of the Stars Is the Terrestrial Present.*—We have seen that light is not transmitted instantaneously from one point to another, but gradually, like everything movable; that it flies at the rate of 186,000 miles a second, or 11 millions of miles in one minute; that it takes more than eight minutes to pass over the distance which separates us from the sun, four hours to come from Neptune, and four years and four months to come from the nearest star, etc.

There is here, then, a surprising transformation of the past into the present. For the star observed, it is the past—already vanished. For the observer, it is the pres-

ent, the now. The past of a star is strictly and positively the present of the observer. As the aspect of worlds changes from year to year, from one season to another, and almost from one day to the next, we can represent this aspect as escaping into space and advancing in infinitude to reveal itself to the eyes of distant beholders. Each aspect is followed by another, and so on successively; and it is as if a series of waves bearing from afar the past of worlds should become present to observers ranged along its passage! What we believe we see now in the stars is already past; and what is now being accomplished we do not yet see.—FLAMMARION *Popular Astronomy*, bk. vi, ch. 6, p. 616. (A.)

3463. TRANSFORMATION OF RAILWAY INTO TELEPHONE CIRCUIT—Another striking illustration [of electrical conduction without wires] is furnished by Professor Blake, of Brown University, . . . who talked with a friend for some distance along a railway (using the two lines of rails for the telephonic circuit), hearing at the same time the Morse signals passing along the telegraph wires overhead.—FAHIE *Wireless Telegraphy*, p. 85. (D. M. & Co., 1900.)

3464. TRANSFORMATION OF UNSEEN PRODUCTS OF COMBUSTION—*Beauty and Warmth Arise from Destruction.*—[The floating] smoke, tho so long unnoticed by man, was not overlooked by the Author of Nature. It is a part of his grand and beneficent design in the scheme of organic nature. No sooner do the products of that wood burning on the hearth escape into the free expanse of the outer air, than a new cycle of changes begins. The carbonic dioxid and the aqueous vapor, after roving at liberty for a time, are absorbed by the leaves of some wide-spreading tree, smiling in the sunshine, and in the tiny laboratory of their green cells are worked up by those wonderful agents, the sun-rays, into new wood, absorbing from the sun a fresh supply of power, which is destined, perhaps, to shed warmth and light around the fireside of a future generation.—COOKE *Religion and Chemistry*, ch. 3, p. 80. (A., 1897.)

3465. TRANSFORMATION WROUGHT BY SUNLIGHT—*Waste Products Utilized—A Lily in the Black Hole of Calcutta.*—The sunbeam . . . does what our wisest chemistry cannot do: it takes the burned-out ashes and makes them anew into green wood; it takes the close and breathed-out air and makes it sweet and fit to breathe by means of the plant, whose food is the same as our poison. With the aid of sunlight a lily would thrive on the deadly atmosphere of the "black hole of Calcutta"; for this bane to us, we repeat, is vital air to the plant, which breathes it in through all its pores, bringing it into contact with the chlorophyl, its green blood, which is to it what the red blood is to us; doing almost everything, however, by means of the sunray, for if this be lacking, the oxygen is no longer set free or the carbon retained, and the plant dies. This too brief statement must answer instead of a fuller description of how the sun's energy builds up the vegetable world.—LANGLEY *New Astronomy*, ch. 3, p. 73. (H. M. & Co., 1896.)

3466. TRANSFORMATION WROUGHT BY WORMS—*The "Wilderness Turned into a Fruitful Field"—Beneficent Work of Unconsidered or Despised Organisms.*—A field . . . , which was last plowed in 1841, was then harrowed and left to become pasture-land. For several years it was clothed with an extremely scant vegetation, and was so thickly covered with small and large flints (some of them half as large as a child's head) that the field was always called by my sons "the stony field." When they ran down the slope the stones clattered together. I remember doubting whether I should live to see these larger flints covered with vegetable mold and turf. But the smaller stones disappeared before many years had elapsed, as did every one of the larger ones after a time; so that after thirty years (1871) a horse could gallop over the compact turf from one end of the field to the other, and not strike a single stone with his shoes. To any one who remembered the appearance of the field in 1842, the transformation was wonderful. This was certainly the work of the worms, for tho castings were not frequent for several years, yet some were thrown up month after month, and these gradually increased in numbers as the pasture improved. In the year 1871 a trench was dug on the above slope, and the blades of grass were cut off close to the roots, so that the thickness of the turf and of the vegetable mold could be measured accurately. The turf was rather less than half an inch, and the mold, which did not contain any stones, 2½ inches in thickness. Beneath this lay coarse, clayey earth full of flints, like that in any of the neighboring plowed fields. This coarse earth easily fell apart from the overlying mold when a spit was lifted up. The average rate of accumulation of the mold during the whole thirty years was only .083 inch per year (*i. e.*, nearly one inch in twelve years); but the rate must have been much slower at first, and afterwards considerably quicker.—DARWIN *Formation of Vegetable Mould*, ch. 3, p. 41. (Hum., 1887.)

3467. TRANSITION FROM BIRDS TO REPTILES—*Fossil Connecting-links Are Found.*—When compared with other animals, birds are found to occupy second place in the scale of life. They stand between mammals and reptiles, and are more closely related to the latter than to the former. In fact, certain extinct birds so clearly connect living birds with reptiles that these two classes are sometimes placed in one

group—the *Sauropsida*. . . . There is good evidence for the belief that birds have descended from reptilian ancestors. This evidence consists of the remains of fossil birds, some of which show marked reptilian characters, and are toothed.—CHAPMAN *Bird-Life*, ch. 1, p. 1. (A., 1900.)

3468. TRANSITION FROM BRONZE TO IRON AGE—*Barbarism Surpassing Civilization.*—It is especially difficult to determine the positive date when any nation made the transition from the Bronze to the Iron Age, and practically impossible to do so in the cases of people who either inhabited countries where iron does not abound, or who never acquired the art of obtaining it. In such event, the substitution of implements of iron necessarily imported from other countries for the native ones of bronze, to which the population had become accustomed by ages of use, was an exceedingly slow process, retarded by the mental inertia of the times, and often by national pride in home customs and handiwork. Hence arises the seeming anomaly that among people far advanced in civilization the general use of iron can be recognized only at a comparatively late period in their history; while among barbarians, incomparably below them in intellectual attainments, we find evidence of its employment at immensely earlier periods. In Denmark, for example, the Age of Iron corresponds to that of the beech-tree. Hesiod, writing in 850 B. C., speaks of the time when "men wrought in brass, when iron did not exist"; and Homer, altho frequently referring to weapons and implements of bronze, mentions iron but rarely. The Aztecs, at the time of the Conquest, knew nothing of the metal, altho their soil was impregnated with it. The Peruvians, under the same natural conditions, were equally ignorant.—PARK BENJAMIN *Intellectual Rise in Electricity*, ch. 1, p. 21. (J. W., 1898.)

3469. TRANSITION FROM NATURAL TO SPIRITUAL—*Like That from Mineral to Organic Life.*—Why a virtuous man should not simply grow better and better until in his own right he enter the kingdom of God is what thousands honestly and seriously fail to understand. Now philosophy cannot help us here. Her arguments are, if anything, against us. But science answers to the appeal at once. If it be simply pointed out that this is the same absurdity as to ask why a stone should not grow more and more living till it enters the organic world, the point is clear in an instant.—DRUMMOND *Natural Law in the Spiritual World*, essay 1, p. 71. (H. Al.)

3470. TRANSITION FROM TYPE TO TYPE—*Species United by Steady Gradation of Varieties.*—In the small forest region of Oahu, one of the Sandwich Islands, there have been found about 175 species of land-shells represented by 700 or 800 varieties; and we are told by the Rev. J. T. Gulick, who studied them carefully, that "we frequently find a genus represented in several successive valleys by allied species, sometimes feeding on the same, sometimes on different plants. In every such case the valleys that are nearest to each other furnish the most nearly allied forms; and a full set of the varieties of each species presents a minute gradation of forms between the more divergent types found in the more widely separated localities."—WALLACE *Darwinism*, ch. 3, p. 29. (Hum.)

3471. TRANSITION, GRADUAL, OF GROUPS AND SPECIES IN GEOLOGIC TIMES—If there be any result which has come more clearly out of geological investigation than another, it is that the vast series of extinct animals and plants is not divisible, as it was once supposed to be, into distinct groups, separated by sharply marked boundaries. There are no great gulfs between epochs and formations—no successive periods marked by the appearance of plants, of water animals, and of land animals, *en masse*. Every year adds to the list of links between what the older geologists supposed to be widely separated epochs. . . . This truth is further illustrated in a most interesting manner by the impartial and highly competent testimony of M. Pictet, from whose calculations of what percentage of the genera of animals, existing in any formation, lived during the preceding formation, it results that in no case is the proportion less than one-third, or 33 per cent.; . . . other formations not uncommonly exhibit 60, 80, or even 94 per cent. of genera in common with those whose remains are embedded in their predecessor.—HUXLEY *Lay Sermons*, serm. 12, p. 280. (G. P. P., 1899.)

3472. TRANSITION, SCIENCE IN STATE OF—*Miasma and Malaria but Partially Understood.*—The term "miasm" has had an extensive and somewhat diffuse application in medical science. It may happen in the future that typhoid will be classified strictly as a miasmatic disease. But at present, in the transition state of the science, it would hardly be justifiable to classify typhoid with a typically miasmatic disease like malaria. Yet it is clear that mention should here be made of a group of diseases of which malaria is the type, and of which the tropics generally are the native land. The bacterial etiology of the group is by no means worked out. The cause of malaria alone is not yet a closed subject. However the details of the etiology of this group finally arrange themselves, there is little doubt of two facts, viz., the diseases are probably produced by bacteria or allied protozoa, and soil plays an important part in their production.—NEWMAN *Bacteria*, ch. 5, p. 177. (G. P. P., 1899.)

3473. TRANSITORINESS OF HUMAN MEMORIALS—We can foresee no limit to the perpetuation of some of the memorials of man, which are continually entombed in the bowels of the earth or in the bed of the ocean. . . .

Yet it is no less true, as a late distinguished philosopher [Davy] has declared, "that none of the works of a mortal being can be eternal." They are in the first place wrested from the hands of man, and lost as far as regards their subserviency to his use, by the instrumentality of those very causes which place them in situations where they are enabled to endure for indefinite periods. And even when they have been included in rocky strata, when they have been made to enter, as it were, into the solid framework of the globe itself, they must nevertheless eventually perish; for every year some portion of the earth's crust is shattered by earthquakes, or melted by volcanic fire, or ground to dust by the moving waters on the surface. "The river of Lethe," as Bacon eloquently remarks, "runneth as well above ground as below."—LYELL *Principles of Geology*, bk. iii, ch. 48, p. 764. (A., 1854.)

3474. TRANSITORINESS OF LAND-FORMATIONS — *Islands Built Up and Destroyed in the Ganges.*—Major R. H. Colebrooke, in his account of the course of the Ganges, relates examples of the rapid filling up of some of its branches, and the excavation of new channels, where the number of square miles of soil removed in a short time (the column of earth being 114 feet high) was truly astonishing. Forty square miles, or 25,600 acres, are mentioned as having been carried away, in one place, in the course of a few years. The immense transportation of earthy matter by the Ganges and Brahmaputra is proved by the great magnitude of the islands formed in their channels during a period far short of that of a man's life. Some of these, many miles in extent, have originated in large sand-banks thrown up round the points at the angular turning of the rivers, and afterwards insulated by breaches of the streams. Others, formed in the main channel, are caused by some obstruction at the bottom. A large tree or a sunken boat is sometimes sufficient to check the current, and cause a deposit of sand, which accumulates till it usurps a considerable portion of the channel. The river then undermines its banks on each side to supply the deficiency in its bed, and the island is afterwards raised by fresh deposits during every flood. In the great gulf below Luckipour, formed by the united waters of the Ganges and Megna, some of the islands, says Rennell, rival in size and fertility the isle of Wight. While the river is forming new islands in one part, it is sweeping away old ones in others. Those newly formed are soon overrun with reeds, long grass, the *Tamarix Indica*, and other shrubs, forming impenetrable thickets, where the tiger, the rhinoceros, the buffalo, deer, and other wild animals, take shelter. It is easy, therefore, to perceive that both animal and vegetable remains may occasionally be precipitated into the flood and become embedded in the sediment which subsides in the delta.—LYELL *Principles of Geology*, bk. ii, ch. 18, p. 277. (A., 1854.)

3475. TRANSITORINESS OF OUR UNIVERSE—*Some Greater All-embracing Reality.*—These impressions are strengthened rather than weakened when we come back from the outer universe to our own little solar system; for every process which we know tends to the dissipation, or rather the degradation, of heat, and seems to point, in our present knowledge, to the final decay and extinction of the light of the world. In the words of one of the most eminent living students of our subject, "The candle of the sun is burning down, and, as far as we can see, must at last reach the socket. Then will begin a total eclipse which will have no end.

'Dies iræ, dies illa,
Solvet sæclum in favilla.' "

Yet tho it may well be that the fact itself here is true, it is possible that we draw the moral to it unawares, from an unacknowledged satisfaction in the idea of the vastness of the funeral pyre provided for such beings as ourselves, and that it is pride, after all, which suggests the thought that when the sun of the human race sets, the universe will be left tenantless, as a body from which the soul has fled. Can we not bring ourselves to admit that there may be something higher than man and more enduring than frail humanity, in some sphere in which our universe, conditioned as it is in space and time, is itself embraced, and so distrust the conclusions of man's reason where they seem to flatter his pride?—LANGLEY *The New Astronomy*, ch. 8, p. 249. (H. M. & Co., 1896.)

3476. TRANSMISSION OF RADIANT HEAT—*Adventure on Railroad—Power of Unseen Forces.*—I once had an opportunity to observe the wonderful rapidity with which light and radiant heat are transmitted through glass, which is transparent to both. I was at Vancouver, at the terminus of the Canadian Pacific Railway, on Burrard Inlet. We started for Winnipeg about noon, and six miles out the train was stopped by a burning woodpile of large dimensions within a few feet of the track. After two hours of waiting the wood had been reduced to a huge pile of glowing coals. The conductor concluded to run past at a high rate of speed; so backing up about one-half mile they put on a full head of steam and ran past the fire at a tremendous speed. I was in a stateroom, and the passageway around it was between me and the fire, so that the heat and light had to pass through two win-

dows before it reached me. I stood in the stateroom, looking in the direction of the fire, so as to get a glimpse of it as we ran by. The time that my face was exposed was only a small fraction of a second, and the heat had to come through the glass of two windows some distance apart, and yet my face was burned to redness. The glass was not heated, but the sides of the cars were burned into blisters. The one was a transparent and the other an opaque substance.—ELISHA GRAY *Nature's Miracles,* vol. ii, ch. 23, p. 194. (F. H. & H., 1900.)

3477. TRANSMISSION OF RETRIEVER'S INSTINCT — *Heredity of Acquired Characters.*—The fixed and deliberate stand of the pointer has with propriety been regarded as a mere modification of a habit, which may have been useful to a wild race accustomed to wind game, and steal upon it by surprise, first pausing for an instant in order to spring with unerring aim. The faculty of the retriever, however, may justly be regarded as more inexplicable and less easily referable to the instinctive passions of the species. M. Majendie, says a French writer in a recently published memoir, having learned that there was a race of dogs in England which stopped and brought back game of their own accord, procured a pair, and having obtained a whelp from them, kept it constantly under his eyes until he had an opportunity of assuring himself that, without having received any instruction, and on the very first day that it was carried to the chase, it brought back game with as much steadiness as dogs which had been schooled into the same maneuver by means of the whip and collar. [See HEREDITY OF ACQUIRED CHARACTERS.]—LYELL *Principles of Geology,* bk. iii, ch. 35, p. 594. (A., 1854.)

3478. TRANSPARENCY NEVER PERFECT—*A Sufficient Depth of Water Absorbs All Light—Increase of Quantity Reverses Result.*—All bodies, even the most transparent, are more or less absorbent of light. Take the case of water: in small quantities it does not sensibly affect light. A glass cell of clear water interposed in the track of our beam does not perceptibly change any one of the colors of the spectrum derived from the beam. Still absorption, tho insensible, has here occurred, and to render it sensible we have only to increase the depth of the water through which the light passes. Instead of a cell an inch thick let us take a layer ten or fifteen feet thick; the color of the water is then very evident. By augmenting the thickness we absorb more of the light, and by making the thickness very great we absorb the light altogether. Lampblack or pitch can do no more, and the only difference between them and water is that a very small depth in their case suffices to extinguish all the light. The difference between the highest known transparency and the highest known opacity is one of degree merely.—TYNDALL *Lectures on Light,* lect. 1, p. 35. (A., 1898.)

3479. TRANSPORTATION BY STAGES—*Nature's Ice-boats—Locust-seeds Borne on Wings of Wind.*—And the wind is sure to come along, a slight breeze to-day tossing the half-pod a few feet, leaving it perhaps to be again and again moved farther forward. The writer has seen these half-pods [of the locust] transported by this means more than a block. But many of the pods stick to the limbs till winter comes. Then a breeze tears off a few pods and they fall on the snow, which has filled up all the crevices in the grass and between the dead leaves and rubbish. Each half-pod, freighted with every other seed, is admirably constructed; like an ice-boat, it has a sail always spread to the breeze. In this way there is often nothing to hinder some of the seeds from going a mile or two in a few minutes, now and then striking some object which jars off a seed or two. The seeds are very hard, and no doubt purposely so, that they may not be eaten by insects or birds; but once in moist soil the covering slowly swells and decays, allowing the young plant to escape. Thus the locust-seeds are provided with neither legs, wings, fins, nor do they advertise by brilliant hue and sweet pulp; but they travel in a way of their own, which is literally on the wings of the wind.—BEAL *Seed Dispersal,* ch. 5, p. 56. (G. & Co., 1898.)

3480. TRAVELING, THREE RAPID MODES OF—*Maximum Speed of Horse Nearly Reached—Possibilities of the Bicycle.*—It is a very interesting fact that three out of the four methods of rapid locomotion we now possess should have attained about the same maximum speed. The racehorse, the steamship, and the bicycle have each of them reached thirty miles an hour. The horse is, however, close upon, if it has not actually attained, its utmost limits: the bicycle can already beat the horse for long distances, and will certainly go at higher speeds for short ones; while the steamship will also go much quicker, tho how much no one can yet say. The greatest possibilities are with the bicycle driven by electric power or compressed air, by which means, on a nearly straight and fairly level asphalt track, no doubt fifty miles an hour will soon be reached.—WALLACE *The Wonderful Century,* ch. 1, p. 9. (D. M. & Co., 1899.)

3481. TREE, LIMITED CORRESPONDENCE OF, WITH ITS ENVIRONMENT—*Irresponsiveness Is Death.*—Different organisms correspond with [their] environment in varying degrees of completeness or incompleteness. At the bottom of the biological scale we find organisms which have only the most limited correspondence with their surroundings. A tree, for example, corresponds with the soil about its stem,

with the sunlight, and with the air in contact with its leaves. But it is shut off by its comparatively low development from a whole world to which higher forms of life have additional access. The want of locomotion alone circumscribes most seriously its area of correspondence, so that to a large part of surrounding Nature it may truly be said to be dead. So far as consciousness is concerned, we should be justified, indeed, in saying that it was not alive at all. The murmur of the stream which bathes its roots affects it not. The marvelous insect life beneath its shadow excites in it no wonder. The tender maternity of the bird which has its nest among its leaves stirs no responsive sympathy. It cannot correspond with those things. To stream and insect and bird it is insensible, torpid, dead. For this is death, this irresponsiveness.—DRUMMOND *Natural Law in the Spiritual World*, essay 4, p. 138. (H. Al.)

3482. TREE-FERNS OF THE TROPICS—*A Climate of Perpetual Spring.*—The form of ferns . . . , like that of grasses, also assumes nobler dimensions in the torrid regions of the earth, and the arborescent ferns, which frequently attain the height of above forty feet, have a palm-like appearance, altho their stem is thicker, shorter, and more rough and scaly than that of the palm. The leaf is more delicate, of a loose and more transparent texture, and sharply serrated on the margins. These colossal ferns belong almost exclusively to the tropics, but there they prefer the temperate localities. As in these latitudes diminution of heat is merely the consequence of an increase of elevation, we may regard mountains that rise 2,000 or 3,000 feet above the level of the sea as the principal seat of these plants. Arborescent ferns grow in South America, side by side with that beneficent tree whose stem yields the febrifuge bark, and both forms of vegetation are indicative of the happy region where reigns the genial mildness of perpetual spring.—HUMBOLDT *Views of Nature*, p. 230. (Bell, 1896.)

3483. TREES, COLOSSAL, OF TROPICS—*Crown Like Domed Cathedral—The Giant Must Dwell Alone.*—What attracted us chiefly were the colossal trees. The general run of trees had not remarkably thick stems; the great and uniform height to which they grow without emitting a branch was a much more noticeable feature than their thickness; but at intervals of a furlong or so a veritable giant towered up. Only one of these monstrous trees can grow within a given space; it monopolizes the domain, and none but individuals of much inferior size can find a footing near it. The cylindrical trunks of these larger trees were generally about 20 to 25 feet in circumference. Von Martius mentions having measured trees in the Pará district, belonging to various species (*Symphonia coccinea Lecythis sp.* and *Cratæva Tapia)*, which were 50 to 60 feet in girth at the point where they become cylindrical. The height of the vast column-like stems could not be less than 100 feet from the ground to their lowest branch. Mr. Leavens, at the sawmills, told me they frequently squared logs for sawing 100 feet long, of the Pao d'Arco and the Massaranduba. The total height of these trees, stem and crown together, may be estimated at from 180 to 200 feet; where one of them stands, the vast dome of foliage rises above the other forest-trees as a domed cathedral does above the other buildings in a city.—BATES *Naturalist on the River Amazon*, ch. 2, p. 635. (Hum., 1880.)

3484. TRIAL, FIERY, PRECIOUS RESULTS OF—*Gems the Products of Volcanoes—Crystallization through Pressure and Fierce Heat Gives Them All Their Value.*—Among the most interesting effects resulting from the extrusion of masses of incandescent rock, charged with water and various gases, through beds of limestone, clay, sandstone, etc., we may mention the production of those beautiful crystalline minerals which adorn our museums and are so highly prized as gems. By far the larger part of these beautiful minerals have been formed, directly or indirectly, by volcanic agencies.

These gems and beautiful minerals are, for the most part, substances of every-day occurrence, which entirely owe their beauty to the crystalline forms they have assumed. The diamond is crystallized carbon, the ruby and sapphire are crystallized aluminum, the amethyst and a host of other gems are crystallized silica; and in almost all cases the materials of gems are common and widely diffused; it is only in their finely crystalline condition that they are rare and therefore valuable.—JUDD *Volcanoes*, ch. 5, p. 146. (A., 1899.)

3485. TRIUMPH OF SCIENCE—*Cuvier Reproduces from Fragments Extinct Animals—Complete Specimens Later Verify His Theory.*—At length there was discovered at Montmartre an upper jaw of the same [unknown] animal, next a lower jaw, matching the upper one, and presently a whole head, with a few backbones, was brought to light. These were enough, with Cuvier's vast knowledge of animal structure, to give him a key to the whole skeleton. At about the same time, in the same locality, were found other bones and teeth also, differing from those first discovered, and yet equally unlike those of any living animal. The first evidently belonged to some stout and heavy animal, the others were more slender and of lighter build. From these fragments, ample evidence to him of his results, he drew the outlines of two animals: one which he called the *Palæotherium* (old animal) . . . , and the other *Anoplotherium* (animal without fangs). He presented these figures with an explanatory memoir at the Academy, and announced

them as belonging to some creation preceding the present, since no such animals had ever existed in our own geological period. Such a statement was a revelation to the scientific world; some looked upon it with suspicion and distrust; others, who knew more of comparative anatomy, hailed it as introducing a new era in science; but it was not till complete specimens were actually found of animals corresponding perfectly to those figured and described by Cuvier, proving beyond a doubt their actual existence in ancient times, that all united in wonder and admiration at the result obtained by him with such scanty means.—AGASSIZ *Geological Sketches*, ser. i, ch. 7, p. 185. (H. M. & Co., 1896.)

3486. ———— *Kepler's Laws—His Joy in Proving the Harmony of the Universe.*—It was thus that Kepler viewed this last discovery of his. His fervent disposition was roused to earnest enthusiasm when he had found this law of harmony in the universe. He felt instinctively that he was approaching a yet grander discovery, or that at least he had shown the path by which a greater truth was to be reached and the law of the universe recognized. He might have spoken of himself, had he known what was to come, as the Moses of the astronomy of the future, who saw the promised land afar off, but entered not therein. But he chose rather to use the words of the ancient mystics: "I will rejoice!" he exclaimed; "I will triumph in my sacred fury; for I have found the golden vases of the Egyptians!"*—PROCTOR *Expanse of Heaven*, p. 109. (L. G. & Co., 1897.)

3487. ———— *Result Attained After Long Discouragement—Newton's Discovery of Gravitation Confirmed—Patience and Exactness of Science.*—At the time when Newton attempted to make this comparison between gravity at the surface of the earth and the force which keeps the moon in her orbit, the diameter of the terrestrial globe was not known with sufficient exactness. The result did not completely answer his expectations; he found for the distance which the moon falls towards the earth in one second a little less than the twentieth of an inch (it should be a little more, about 0.053 inch); but altho the difference was not large it appeared sufficient to prevent him from inferring the identity which he hoped to find. The cause of his failure was not explained till sixteen years later. In the year 1682, being present at a meeting of the Royal Society of London, he heard mentioned a new measure of the earth made by the French astronomer Picard, and having obtained the result which that astronomer had found, he again took up the calculation which he had attempted sixteen years previously, employing the new data; but as he proceeded the desired precision came with evidence more and more luminous; the thinker became as if mentally dazed, and felt seized with such emotion that he could not continue, and begged one of his friends to finish the calculation.—FLAMMARION *Popular Astronomy*, bk. ii, ch. 1, p. 92. (A.)

* Referring to the belief of the Pythagoreans that certain sacred secrets were preserved in golden vases shown to Pythagoras by Egyptian priests.

3488. ———— *Terrestrial Substances in the Sun—Revelations of the Spectroscope.*—It has long been supposed that the sun and planets have had a common origin, and that hence the same substances are common to them all. Can we, then, detect the presence of any of our terrestrial substances in the sun? We have learned that the bright bands of a metal are characteristic of the metal; that we can, without seeing the metal, declare its name from the inspection of its bands. The bands are, so to speak, the voice of the metal declaring its presence. Hence, if any of our terrestrial metals be contained in the sun's atmosphere, the dark lines which they produce ought to coincide exactly with the bright lines emitted by the vapor of the metal itself. About sixty bright lines have been determined as belonging to the single metal iron. If the light from the incandescent vapor of iron, obtained by passing electric sparks between two iron wires, be allowed to pass through one-half of a fine slit, and the light of the sun through the other half, the spectra from both sources of light may be placed one underneath the other. When this is done it is found that for every bright line of the iron spectrum there is a dark line of the solar spectrum. Reduced to actual calculation, this means that the chances are more than 1,000,000,000,000,000,000 to 1 that iron is in the atmosphere of the sun. Comparing in the same manner the spectra of other metals, Professor Kirchhoff, to whose genius we owe this splendid generalization, finds iron, calcium, magnesium, sodium, chromium, and many other metals, in the solar atmosphere.—TYNDALL *Heat a Mode of Motion*, lect. 17, p. 512. (A., 1900.)

3489. TRIUMPH OF SPIRIT OVER MATTER—*Scott Composing Waverley Novels.*—"John Ballantyne (whom Scott, while suffering under a prolonged and painful illness, employed as his amanuensis) told me that tho Scott often turned himself on his pillow with a groan of torment, he usually continued the sentence in the same breath. But when dialogue of peculiar animation was in progress spirit seemed to triumph altogether over matter; he arose from his couch and walked up and down the room, raising and lowering his voice, and, as it were, acting the parts. It was in this fashion that Scott produced the far greater portion of the 'Bride of Lammermoor,' the whole of the 'Legend of Montrose,' and almost the whole of 'Ivanhoe'" (Lockhart's "Life of Scott," ch. 44).—CARPENTER *Mental Physiology*, bk. i, ch. 3, p. 139. (A., 1900.)

3490. TRIUMPHS OF MECHANICAL SKILL—*Microscopic Lines Ruled on Glass Plate.*—Let not, then, these numbers [the dimensions of light-waves] impair your confidence in our results; but remember that the microscope reveals a universe with dimensions of the same order of magnitude. Moreover, the magnitudes with which we are here dealing are not beyond the limits of mechanical skill. It is possible to rule lines on a plate of glass so close together that the bands of fine lines thus obtained cannot be resolved even by the most powerful microscopes; and I am informed that the German optician Nobert has ruled bands containing about 224,000 lines to the inch. He regularly makes plates with bands consisting of from about 11,000 to 112,000 lines to the inch. These bands are numbered from the 1st to the 19th, and are used for microscopic tests.—COOKE *New Chemistry*, lect. 1, p. 17. (A., 1899.)

3491. TROPICS, PROLIFIC VEGETATION OF—*Numerous Species of Orchids.*—In the tropics the species [of orchids] are very . . . numerous; thus Fritz Müller found in South Brazil more than thirteen kinds belonging to several genera growing on a single cedrela-tree. Mr. Fitzgerald has collected within the radius of one mile of Sydney in Australia no less than sixty-two species, of which fifty-seven were terrestrial. Nevertheless, the number of individuals of the same species is, I believe, in no country nearly so great as that of very many other plants. Lindley formerly estimated that there were in the world about 6,000 species of *Orchideæ*, included in 433 genera. The number of the individuals which come to maturity does not seem to be at all closely determined by the number of seeds which each species produces; and this holds good when closely related forms are compared.—DARWIN *Fertilization of Orchids*, ch. 9, p. 279. (A., 1898.)

3492. TROPICS, PROTECTIVE COLORS IN—*Why Parrots Are Green.*—Passing on to the tropical regions, it is among their evergreen forests alone that we find whole groups of birds whose ground color is green. Parrots are very generally green, and in the east we have an extensive group of green fruit-eating pigeons; while the barbets, bee-eaters, turacous, leaf-thrushes *(Phyllornis)*, white-eyes *(Zosterops)*, and many other groups have so much green in their plumage as to tend greatly to their concealment among the dense foliage. There can be no doubt that these colors have been acquired as a protection, when we see that in all the temperate regions, where the leaves are deciduous, the ground color of the great majority of birds, especially on the upper surface, is a rusty brown of various shades, well corresponding with the bark, withered leaves, ferns, and bare thickets among which they live in autumn and winter, and especially in early spring, when so many of them build their nests.—WALLACE *Darwinism*, ch. 8, p. 131. (Hum.)

3493. TROPICS, RAINFALL IN THE—*Condensation of Vapor by Mountains—Monsoons.*—Warm, southerly winds, blowing over the Bay of Bengal, and becoming laden with vapor during their passage, reach the low level delta of the Ganges and Brahmaputra, where the ordinary heat exceeds that of the sea, and where evaporation is constantly going on from countless marshes and the arms of the great rivers. A mingling of two masses of damp air of different temperatures probably causes the fall of 70 or 80 inches of rain, which takes place on the plains. The monsoon having crossed the delta, impinges on the Khasia Mountains, which rise abruptly from the plain to a mean elevation of between 4,000 and 5,000 feet. Here the wind not only encounters the cold air of the mountains, but, what is far more effective as a refrigerating cause, the aerial current is made to flow upwards, and to ascend to a height of several thousand feet above the sea. Both the air and the vapor contained in it, being thus relieved of much atmospheric pressure, expand suddenly, and are cooled by rarefaction. The vapor is condensed, and about 500 inches of rain are thrown down annually, nearly twenty times as much as falls in Great Britain in a year, and almost all of it poured down in six months. The channel of every torrent and river is swollen at this season, and much sandstone horizontally stratified, and other rocks are reduced to sand and gravel by the flooded streams.—LYELL *Principles of Geology*, bk. ii, ch. 14, p. 200. (A., 1854.)

3494. ——— ——— *Landslides—The Turbid Ganges.*—In another part of India [see 3493], immediately to the westward, similar phenomena are repeated. The same warm and humid winds, copiously charged with aqueous vapor from the Bay of Bengal, hold their course due north for 300 miles across the flat and hot plains of the Ganges, till they encounter the lofty Sikkim Mountains. On the southern flank of these they discharge such a deluge of rain that the rivers in the rainy season rise twelve feet in as many hours. Numerous landslips, some of them extending three or four thousand feet along the face of the mountains, composed of granite, gneiss, and slate, descend into the beds of streams, and dam them up for a time, causing temporary lakes, which soon burst their barriers. "Day and night," says Dr. Hooker, "we heard the crashing of falling trees and the sound of boulders thrown violently against each other in the beds of torrents. By such wear and tear rocky fragments swept down from the hills are in part converted into sand and fine mud; and the turbid Ganges, during its annual inundation, derives more of its

sediment from this source than from the waste of the fine clay of the alluvial plains below.—LYELL *Principles of Geology*, bk. ii, ch. 14, p. 201. (A., 1854.)

3495. TRUSTWORTHINESS OF NATURAL FORCES—*A Belief as Old as Humanity.*—Even the modern idea of law, of the constancy and therefore the trustworthiness of natural forces, has been known, not indeed scientifically but instinctively, to man since first he made a tool and used it as the instrument of purpose. What has science added to this idea, except that the same rule prevails as widely as the universe, and is made subservient in a like manner to knowledge and to will?—ARGYLL *Reign of Law*, ch. 2, p. 69. (Burt.)

3496. TRUTH, ABSOLUTE, UNATTAINABLE BY MAN—Absolute truth no man of science can ever hope to grasp; for he knows that all human search for it must be limited by human capacity.—CARPENTER *Nature and Man*, essay 7, p. 238. (A., 1889.)

3497. TRUTH IN ANCIENT THEORIES—*Hot Springs—Heat of Interior of the Earth.*—The observation made by Arago in 1821, that the deepest Artesian wells are the warmest, threw great light on the origin of thermal springs, and on the establishment of the law that terrestrial heat increases with increasing depth. It is a remarkable fact, which has but recently been noticed, that at the close of the third century St. Patricius, probably Bishop of Pertusa, was led to adopt very correct views regarding the phenomenon of the hot springs at Carthage. On being asked what was the cause of boiling water bursting from the earth, he replied: "Fire is nourished in the clouds and in the interior of the earth, as Etna and other mountains near Naples may teach you. The subterranean waters rise as if through siphons. The cause of hot springs is this: waters which are more remote from the subterranean fire are colder, while those which rise nearer the fire are heated by it and bring with them to the surface which we inhabit an insupportable degree of heat."—HUMBOLDT *Cosmos*, vol. i, p. 223. (H., 1897.)

3498. TRUTH, LIKE NATURE'S GIFTS, TO BE WORKED FOR—Nature never provides for man's wants in any direction, bodily, mental, or spiritual, in such a form as that he can simply accept her gifts automatically. She puts all the mechanical powers at his disposal—but he must make his lever. She gives him corn, but he must grind it. She elaborates coal, but he must dig for it. Corn is perfect, all the products of Nature are perfect, but he has everything to do to them before he can use them. So with truth; it is perfect, infallible. But he cannot use it as it stands. He must work, think, separate, dissolve, absorb, digest; and most of these he must do for himself and within himself.—DRUMMOND *Natural Law in the Spiritual World*, essay 10, p. 326. (H. Al.)

3499. TRUTH LOVED MORE THAN THEORY — *Kepler Abandons Systems that Conflict with Facts.*—What love of the truth as it is in Nature was ever more conspicuous than that which Kepler displayed in his abandonment of each of the ingenious conceptions of the planetary system which his fertile imagination had successively devised, so soon as it proved to be inconsistent with the facts disclosed by observation? In that almost admiring description of the way in which his enemy Mars, "whom he had left at home a despised captive," had "burst all the chains of the equations, and broke forth from the prisons of the tables," who does not recognize the justice of Schiller's definition of the real philosopher, as one who always loves truth better than his system?—CARPENTER *Nature and Man*, essay 6, p. 188. (A., 1889.)

3500. TRUTH, PHYSICIAN DRIVEN TO SEEK—*Responsibility of Life or Death Compels.*—One who, like the physician, has actively to face natural forces which bring about weal or woe is also under the obligation of seeking for a knowledge of the truth, and of the truth only, without considering whether what he finds is pleasant in one way or the other. His aim is one which is firmly settled: for him the success of facts is alone finally decisive. He must endeavor to ascertain beforehand what will be the result of his attack if he pursues this or that course.—HELMHOLTZ *Popular Lectures*, lect. 5, p. 225. (L. G. & Co., 1898.)

3501. TRUTH, SCIENTIFIC, AGREEING WITH POPULAR OBSERVATION—There is another fact of common observation, and now scientifically established: strong scintillations foretell rain. It is the presence of water in greater or less quantity in the atmosphere which exercises the most marked influence on the scintillation, and which modifies its character according to the quantity, either when the water is dissolved in the air, or when it falls to the level of the ground in the liquid state, or in the solid state in the form of snow.—FLAMMARION *Popular Astronomy*, bk. vi, ch. 6, p. 607. (A.)

3502. TRUTH, SIMPLE, OVERLOOKED — *Transparency Invisible.* — It is probably the very simplicity of the law regarding it [spiritual conformity to type] that has made men stumble; for nothing is so invisible to most men as transparency.—DRUMMOND *Natural Law in the Spiritual World*, essay 8, p. 275. (H. Al.)

3503. TRUTH THE CRITERION OF POETRY— *Tennyson's "Dragon-fly"—Truth to Nature Increases Poetic Charm.*—The criterion of perfect poetry is not elegance, but truth; and that in proportion as the poet's

knowledge of Nature is true, so will his work represent the thoughts which have power to charm, instruct, and better mankind through all time. I know of no better example of the complete reconcilement of poesy and an accurate knowledge of Nature than is contained in Tennyson's "Two Voices." Let any one watch the birth of a dragon-fly, and say whether or not the poet has written sweetly and well—and all the more sweetly because his words are true:

To-day I saw a dragon-fly
Come from the wells where he did lie.

An inner impulse rent the veil
Of his old husk: from head to tail
Came out clear plates of sapphire mail.

He dried his wings: like gauze they grew;
Through crofts and pastures wet with dew
A living flash of light he flew.

—ANDREW WILSON *Science and Poetry*, p. 11. (Hum., 1888.)

3504. TUTELAGE PROLONGED BY CIVILIZATION—*More Time Needed to Prepare for the More Complex Life.*—Now it is owing to the necessity for having a certain number of the more useful routes established before the babe can be trusted from its mother's side that the delay of infancy is required. And even after the child has begun to practise the art of living for itself, time has still to be granted for many purposes—for new route-making, for becoming familiar with established thoroughfares, for practising upon obstacles and ingredients, for learning to perform the journeys quickly and without fatigue, for allowing acts repeated to accelerate and embody themselves as habits. In the savage state, where the after-life is simple, the adjustments are made with comparative ease and speed; but as we rise in the scale of civilization the necessary period of infancy lengthens step by step, until in the case of the most highly educated man, where adjustments must be made to a wide intellectual environment, the age of tutelage extends for almost a quarter of a century.—DRUMMOND *Ascent of Man*, ch. 8, p. 287. (J. P., 1900.)

3505. TWINKLING OF STARS EXPLAINED—*Interference of Light-waves—Iridescence of Striated Surfaces—The Colors of Mother-of-pearl Transferred to Black Sealing-wax.*—By interference in the earth's atmosphere the light of a star, as shown by Arago, is self-extinguished, the twinkling of the star and the changes of color which it undergoes being due to this cause. Looking at such a star through an opera-glass, and shaking the glass so as to cause the image of the star to pass rapidly over the retina, you produce a row of colored beads, the spaces between which correspond to the periods of extinction. Fine scratches drawn upon glass or polished metal reflect the waves of light from their sides; and some, being reflected from opposite sides of the same scratch, interfere with and quench each other. But the obliquity of reflection which extinguishes the shorter waves does not extinguish the longer ones, hence the phenomena of color. These are called the colors of striated surfaces. They are beautifully illustrated by mother-of-pearl. This shell is composed of exceedingly thin layers, which, when cut across by the polishing of the shell, expose their edges and furnish the necessary small and regular grooves. The most conclusive proof that the colors are due to the mechanical state of the surface is to be found in the fact, established by Brewster, that by stamping the shell carefully upon black sealing-wax we transfer the grooves, and produce upon the wax the colors of mother-of-pearl.—TYNDALL *Lectures on Light*, lect. 2, p. 92. (A., 1898.)

3506. TYPE, COMMON, TRACED THROUGH ALL VERTEBRATES—*Legs of Whale and Boa-constrictor.*—The general law to be learned from the series of skeletons in a natural-history museum is that through order after order of fishes, reptiles, birds, beasts, up to man himself, a common type or pattern may be traced, belonging to all animals which are vertebrate—that is, which have a back-bone. Limbs may still be recognized, tho their shape and service have changed, and tho they may even have dwindled into remnants, as if left not for use, but to keep up the old model. Thus, altho a perch's skeleton differs so much from a man's, its pectoral and ventral fins still correspond to arms and legs. Snakes are mostly limbless, yet there are forms which connect them with the quadrupeds, as, for instance, the boa-constrictor's skeleton shows a pair of rudimentary hind legs. The Greenland whale has no visible hind limbs, and its fore limbs are paddles or flippers; yet when dissected, the skeleton shows not only remnants of what in man would be the leg-bones, but the flipper actually has within it the set of bones which belong to the human arm and hand. It is popularly considered that man is especially distinguished from the lower animals by not having a tail; yet the tail is plainly to be seen in the human skeleton, represented by the last tapering vertebræ of the spine.—TYLOR *Anthropology*, ch. 2, p. 36. (A., 1899.)

3507. UNANIMITY, CONVINCING POWER OF—*Astronomy Trusted Because Astronomers Agree.*—In order that this salutary ascendency over opinion should be exercised by the most eminent thinkers it is not necessary that they should be associated and organized. The ascendency will come of itself when the unanimity is attained, without which it is neither desirable nor possible. It is because astronomers agree in their teaching that astronomy is trusted, and not because there is an Academy of Sciences or a Royal Society issuing decrees or passing resolutions.—MILL *Positive Philosophy of Auguste Comte*, p. 91. (H. H. & Co., 1887.)

3508. ——— ——— *Spectrum Analysis Universally Accepted as Trustworthy.*—I do not know any more remarkable fact

in the psychology of belief than the universality with which even the most wonderful —I might say the most romantic—results of spectrum analysis have been accepted as sober truth, not merely by the whole scientific world, but by the general public. And this universality is, I think, to be attributed to these two conditions: first, that the absolute concurrence of scientific men on this subject gives to their statements the value (if I may so express myself) of bank-notes, which any one may convert into the standard gold of personal knowledge merely by inquiring into the matter for himself; and secondly, that these results are additions to our previous knowledge, and do not run counter to any established beliefs.—CARPENTER *Nature and Man*, lect. 7, p. 236. (A., 1889.)

3509. UNCERTAINTY INEVITABLE —*Atmosphere of Venus Makes Exact Observation of Transit Impossible.*—[At the transit of Venus, 1874] an appearance supervened which took most observers by surprise. This was the illumination due to the atmosphere of Venus. Astronomers, it is true, were not ignorant that the planet had, on previous occasions, been seen girdled with a lucid ring; but its power to mar observations by the distorting effect of refraction had scarcely been reckoned with. It proved, however, to be very great. Such was the difficulty of determining the critical instant of internal contact, that (in Colonel Tupman's words) "observers side by side, with adequate optical means, differed as much as twenty or thirty seconds in the times they recorded for phenomena which they have described in almost identical language." —CLERKE *History of Astronomy*, pt. ii, ch. 6, p. 291. (Bl., 1893.)

3510. UNIFICATION OF THE SCIENCES—*Astronomy Needs and Aids All Other Science—The Universe an Intellectually Consistent Whole.*—The unification of the physical sciences is perhaps the greatest intellectual feat of recent times. The process has included astronomy; so that, like Bacon, she may now be said to have "taken all knowledge" (of that kind) "for her province." In return, she proffers potent aid for its increase. Every comet that approaches the sun is the scene of experiments in the electrical illumination of rarefied matter, performed on a huge scale for our benefit. The sun, stars, and nebulæ form so many celestial laboratories, where the nature and mutual relations of the chemical "elements" may be tried by more stringent tests than sublunary conditions afford. The laws of terrestrial magnetism can be completely investigated only with the aid of a concurrent study of the face of the sun. The positions of the planets will perhaps one day tell us something of impending droughts, famines, and cyclones.—CLERKE *History of Astronomy*, int., p. 7. (Bl., 1893.)

3511. UNIFORMITY OF NATURE— *Ancient Sedimentary Deposits Like the Present—Geological Strata Forming Now.*—The great bulk of the derivative rocks being of sedimentary origin, it is obvious that they must have been at the time of their formation spread out in approximately horizontal layers upon the beds of ancient lakes and seas. This we are justified in believing by what we know of the accumulation of similar sediments in our own day. The wide flats of our river-valleys, the broad plains that occupy the sites of silted-up lakes, the extensive deltas of such rivers as the Nile, the Po, the Amazon, the Mississippi, the narrow or wide belts of low-lying land which within a recent period have been gained from the sea, are all made up of various kinds of sediment arranged in gently inclined or approximately horizontal layers. Now, over considerable areas of the earth's surface the derivative rocks show the same horizontal arrangement, a structure which is obviously original.—GEIKIE *Earth Sculpture*, ch. 1, p. 7. (G. P. P., 1898.)

3512. ——— ——— *Ancient Volcanic Action Like the Modern—Fertility and Happiness in the Intervals.*—If we look at the vast masses of volcanic materials erupted in Miocene times in our own island and in Ireland, for example, we might be led to imagine that we have the indications of a veritable "reign of fire," and that the evidence points to a condition of things very different indeed from that which prevails at the present day. But [we must remember] that these volcanic ejections are not the result of one violent effort, but are the product of numerous small outbreaks which have been scattered over enormous periods of time.

When we examine with due care the lavas, tuffs, and other volcanic ejections which constitute such mountain masses as those of the Hebrides, of the Auvergne, and of Hungary, we find clear proofs that the ancient Miocene volcanoes of these districts were clothed with luxuriant forests, through which wild animals roamed in the greatest abundance. The intervals between the ejections of successive lava-streams were often so great that soils were formed on the mountain slope, and streams cut deep ravines and valleys in them.—JUDD *Volcanoes*, ch. 9, p. 278. (A., 1899.)

3513. ——— ——— *A Revelation of the Immutability of God.*—The chemist in his laboratory, as he questions Nature, may be almost said to put her to the torture when, tried in his hottest furnace, or probed by his searching analysis to her innermost arcana, she by a spark or an explosion, or an effervescence, or an evolving substance, makes her distinct replies to his investigations. And . . . in every quarter of the globe her answer is the same—so that, let the experiment, tho a thousand times re-

peated, only be alike in all its circumstances, the result which cometh forth is as rigidly alike, without deficiency, and without deviation. . . . But there is a God who liveth and sitteth there, and these unvarying responses of Nature are all prompted by himself, and are but the utterances of his immutability. They are the replies of a God who never changes, and who hath adapted the whole materialism of creation to the demonstration of it. The certainties of Nature and of science are, in fact, the vocables by which God announces his truth to the world; and when told how impossible it is that Nature can fluctuate, we are only told how impossible it is that the God of Nature can deceive us.—CHALMERS *Astronomical Discourses*, suppl. disc. 1, p. 213. (R. Ct., 1848.)

3514. ——— ——— *Interruption of—Eclipse of the Sun—Perplexity of Animals.*—The effect of the waning light on animals [during an eclipse of the sun at Rio de Janeiro, 1865] was very striking. The Bay of Rio is daily frequented by large numbers of frigate-birds and gannets, which at night fly to the outer islands to roost, while the carrion-crows *(urubús)* swarming in the suburbs, and especially about the slaughter-houses of the city, retire to the mountains in the neighborhood of Tijuca, their line of travel passing over San Christovão. As soon as the light began to diminish, these birds became uneasy; evidently conscious that their day was strangely encroached upon, they were uncertain for a moment how to act. Presently, however, as the darkness increased, they started for their usual night quarters, the water-birds flying southward, the vultures in a northwesterly direction, and they had all left their feeding-grounds before the moment of greatest obscurity arrived. They seemed to fly in all haste, but were not half-way to their night home when the light began to return with rapidly increasing brightness. Their confusion was now at its height. Some continued their flight towards the mountains or the harbor, others hurried back to the city, while others whirled about wholly uncertain what to do next. The reestablishment of the full light of noon seemed to decide them, however, upon making another day of it, and the whole crowd once more moved steadily toward the city.—AGASSIZ *Journey in Brazil*, ch. 2, p. 52. (H. M. & Co., 1896.)

3515. ——— ——— *Maintained amid Contending Forces.*—Battle within battle must be continually recurring with varying success; and yet in the long run the forces are so nicely balanced that the face of Nature remains for long periods of time uniform, tho assuredly the merest trifle would give the victory to one organic being over another.—DARWIN *Origin of Species*, ch. 1, p. 67. (Burt.)

3516. ——— ——— *Natural Laws Unchanged through All Ages—Limitations of the Doctrine.*—The geological record informs us that the general laws of Nature have continued unchanged from the earliest periods to which it relates until the present day. This is the true "uniformitarianism" of geology which holds to the dominion of existing causes from the first. But it does not refuse to admit variations in the intensity of these causes from time to time, and cycles of activity and repose, like those that we see on a small scale in the seasons, the occurrence of storms, or the paroxysms of volcanoes.—DAWSON *Facts and Fancies in Modern Science*, lect. 3, p. 119. (A. B. P. S.)

3517. ——— ——— *Slow Recognition of the Truth.*—Woodward did not hesitate, in 1695, to teach that the entire mass of fossiliferous strata contained in the earth's crust had been deposited in a few months; and, consequently, as their mechanical and derivative origin was already admitted, the reduction of rocky masses into mud, sand, and pebbles, the transportation of the same to a distance, and their accumulation elsewhere in regular strata, were all assumed to have taken place with a rapidity unparalleled in modern times. This doctrine was modified by degrees, in proportion as different classes of organic remains, such as shells, corals, and fossil plants, had been studied with attention. Analogy led every naturalist to assume that each full-grown individual of the animal or vegetable kingdom had required a certain number of months or years for the attainment of maturity, and the perpetuation of its species by generation; and thus the first approach was made to the conception of a common standard of time, without which there are no means whatever of measuring the comparative rate at which any succession of events has taken place at two distinct periods. This standard consisted of the average duration of the lives of individuals of the same genera or families in the animal and vegetable kingdoms; and the multitude of fossils dispersed through successive strata implied the continuance of the same species for many generations. At length the idea that species themselves had had a limited duration arose out of the observed fact that sets of strata of different ages contained fossils of distinct species. Finally, the opinion became general that in the course of ages one assemblage of animals and plants had disappeared after another again and again, and new tribes had started into life to replace them.—LYELL *Principles of Geology*, bk. i, ch. 10, p. 153. (A., 1854.)

3518. UNION, CHEMICAL, VS. MECHANICAL—*A Mixture Differs from a Compound.*—We cannot say that water consists of hydrogen and oxygen in the same sense that bread consists of flour, or sirup of sugar, and mortar of lime. We must be very careful not to transfer our ideas of composition, drawn chiefly from the mixtures we use in common life, directly to chemis-

try. In these mixtures the product partakes, to a greater or less degree, of the character of its constituents, which can be recognized essentially unchanged in the new material, but, in all instances of true chemical union and decomposition, the qualities of the substances concerned in the process entirely disappear, and wholly different substances, with new qualities, appear in their place. —COOKE *New Chemistry*, lect. 5, p. 114. (A., 1899.)

3519. UNION, CLOSE, OF BODY WITH MIND—*Bodily Processes Affected by Sensations.*—Modern physiological psychology emphasizes the wonderfully delicate way in which the whole nervous mass responds to the slightest phases of change in all forms of excitation, with accompanying modifications of even the lowest possible phases of conscious mental life. Haller, for example, noticed that the noise from beating a drum increased the flow of blood from an open vein. Mosso observed that the approach of a lamp toward a patient whose brain was exposed increased the volume of the brain substance. M. Payot claims to have seen the passage of a cloud over the sun increase the respiratory rhythm and pulse-rate of a sleeping infant. M. Féré found that slight sensations of sound and smell sometimes affect a man's dynamometric force. Schiff and Vulpian have observed the pupils of the eyes dilate under the influence of various forms of excitement. Experiments in reaction-time show that increasing the intensity of conscious states of sensation increases the volume of the blood in the forearm and hand with which the agent is reacting.—LADD *Psychology*, ch. 3, p. 48. (S., 1899.)

3520. UNION OF DANGEROUS SUBSTANCES IN SALT—*Combination Harmless and Useful.*—It is a curious fact in Nature that two such substances as chlorin and sodium, both of them so difficult and dangerous to handle, should unite together to form such a useful and harmless compound as common salt. The important element in bleaching-powder is the chlorin which it contains. It is extensively used in the manufacture of paper and in all other materials where bleaching is required. The object of combining it with lime, forming a chlorid of lime, is simply to have a convenient method of holding the chlorin in a safe and convenient manner until it is needed for use.—ELISHA GRAY *Nature's Miracles*, vol. iii, ch. 26, p. 219. (F. H. & H., 1900.)

3521. UNION OF DISSIMILAR TRAITS—*A Butcher among Song-birds—The Shrike—Hawk's Bill with Sparrow's Foot.*—The marked difference in the temperament of birds is emphasized by finding among the song-birds, who feed on fruit, seeds, and insects, a bird who in his position and choice of food is truly hawklike. Shrikes are solitary, never assembling in flocks or associating with other birds. Their days are days of waiting, varied by a pounce upon some unfortunate field-mouse, or dash into a flock of unsuspecting sparrows. But while they resemble the hawks in these respects, their manner of capturing their prey differs from that of their larger prototypes. The shrike [or butcher-bird] has a hawk's bill, but a sparrow's foot, and, lacking the powerful talons which make so deadly a weapon, he captures his prey with his strong mandibles. Possibly it may be due to his comparatively weak feet that he pursues the singular custom of impaling his prey on some thorn or hanging it from a crotch, where he can better dissect it.—CHAPMAN *Bird-Life*, ch. 7, p. 218. (A., 1900.)

3522. UNION OF LABOR AND ART—Art here [in Italy] stood in close relation with manual labor, and the artist was only distinguished from the manual laborer by higher intellectual gifts.—KAAT *Leonardo da Vinci als Naturforscher.* (Translated for *Scientific Side-Lights.*)

3523. UNION OF RIVERS—*Evils Averted by Nature's Compensation—Speed of Current Increased with Volume.*—A question naturally arises, How the more tranquil rivers of the valleys and plains, flowing on comparatively level ground, can remove the prodigious burden which is discharged into them by their numerous tributaries, and by what means they are enabled to convey the whole mass to the sea? If they had not this removing power their channels would be annually choked up, and the valleys of the lower country and plains at the base of mountain chains would be continually strewed over with fragments of rock and sterile sand. But this evil is prevented by a general law regulating the conduct of running water—that two equal streams do not, when united, occupy a bed of double surface. Nay, the width of the principal river, after the junction of a tributary, sometimes remains the same as before, or is even lessened. The cause of this apparent paradox was long ago explained by the Italian writers, who had studied the confluence of the Po and its feeders in the plains of Lombardy. The addition of a smaller river augments the velocity of the main stream, often in the same proportion as it does the quantity of water. Thus the Venetian branch of the Po swallowed up the Ferranese branch and that of Panaro without any enlargement of its own dimensions. The cause of the greater velocity is, first, that after the union of two rivers the water, in place of the friction of four shores, has only that of two to surmount: secondly, because the main body of the stream being farther distant from the banks, flows on with less interruption; and lastly, because a greater quantity of water, moving more swiftly, digs deeper into the river's bed. By this beautiful adjustment the water which drains the interior country is made continually to occupy less room as it approaches the sea; and thus the most valuable part of our con-

tinents, the rich deltas and great alluvial plains, are prevented from being constantly under water.—LYELL *Principles of Geology,* ch. 14, p. 207. (A., 1854.)

3524. UNION OF WEAKNESS AND STRENGTH—*Plastic Bodies Weak Enough to Yield to an Influence—Strong Enough Not to Yield All at Once.*—Gradual yielding [of plastic bodies] often saves the material from being disintegrated altogether. When the structure has yielded, the same inertia becomes a condition of its comparative permanence in the new form, and of the new habits the body then manifests. Plasticity, then, in the wide sense of the word, means the possession of a structure weak enough to yield to an influence, but strong enough not to yield all at once. Each relatively stable phase of equilibrium in such a structure is marked by what we may call a new set of habits. Organic matter, especially nervous tissue, seems endowed with a very extraordinary degree of plasticity of this sort; so that we may without hesitation lay down as our first proposition the following, that the phenomena of habit in living beings are due to the plasticity of the organic materials of which their bodies are composed.—JAMES *Psychology,* vol. i, ch. 4, p. 104. (H. H. & Co., 1899.)

3525. UNITY AMID DIVERSITY—*Disease Reveals Correlation of Parts of an Organism.*—The truth is that all the parts of an organism are bound together as one whole by a pervading system of correlations as intricate as they are obscure. When the organism is in health, and all its parts are working in harmony, the wonder of these correlations is not perceived. But they are brought out in a marked degree by the phenomena of disease, and also by the phenomena of monstrosity or malformation. The "sympathy" which the most distant and apparently unconnected parts of an organism show with each other, when one of them is affected by disease, is the index of correlations whose nature is utterly beyond the reach of our anatomy.—ARGYLL *Reign of Law,* ch. 5, p. 147. (Burt.)

3526. ——— ——— *Physics and Metaphysics Complementary, Not Antagonistic.*—Thus we arrive at the singular result that, of the two paths opened up to us in the "Discourse upon Method," the one leads, by way of Berkeley and Hume, to Kant and idealism; while the other leads, by way of De la Mettrie and Priestley, to modern physiology and materialism. Our stem divides into two main branches, which grow in opposite ways, and bear flowers which look as different as they can well be. But each branch is sound and healthy, and has as much life and vigor as the other. If a botanist found this state of things in a new plant, I imagine that he might be inclined to think that his tree was monœcious—that the flowers were of different sexes, and that, so far from setting up a barrier between the two branches of the tree, the only hope of fertility lay in bringing them together. I may be taking too much of a naturalist's view of the case, but I must confess that this is exactly my notion of what is to be done with metaphysics and physics. Their differences are complementary, not antagonistic; and thought will never be completely fruitful until the one unites with the other.—HUXLEY *Lay Sermons,* serm. 14, p. 337. (G. P. P., 1899.)

3527. ——— ——— *Uniform Motion of Planets and Satellites—One Common Impulse Affecting All.*—All the planets travel the same way round. This is true not only of the eight primary planets, but of the asteroids, now more than a hundred and thirty in number. Again, all the secondary planets or satellites travel the same way round (this direction of revolution being the same as that in which the planets revolve round the sun)—except the satellites of Uranus, which, however, can hardly be said to have any direction of motion with reference to the general level in which the planetary system circuits, for they travel in planes nearly square to that level. Lastly, as respects direction of motion, all the planets whose rotation has been observed, including our earth and the moon, and the sun also, rotate on their axes in the same direction. It must be understood that this direction is one and the same for all these motions—the revolutions of the planets around the sun, of the satellites round the planets, and of the planets on their axes. It seems natural to infer that the uniformity is the result of some general condition affecting the whole scheme from the beginning.—PROCTOR *Expanse of Heaven,* p. 179. (L. G. & Co., 1897.)

3528. ——— ——— *Various Adjustments Accomplish a Single End—Insects Compelled to Fertilize Orchids.*—Thus the use of all the parts of the flower (namely, the inflected edges, or the polished inner sides of the labellum—the two orifices and their position close to the anthers and stigma—the large size of the medial rudimentary stamen) are rendered intelligible. An insect which enters the labellum is thus compelled to crawl out by one of the two narrow passages, on the sides of which the pollen masses and stigma are placed. We have seen that exactly the same end is gained in the case of *Coryanthes* by the labellum being half filled with secreted fluid; and in the case of *Pterostylis* and some other Australian orchids by the labellum being irritable, so that when touched by an entering insect it shuts up the flower, with the exception of a single narrow passage.—DARWIN *Fertilization of Orchids,* ch. 8, p. 231. (A., 1898.)

3529. "UNITY" BECOMES A SNARE—*Systematizing Overdone—Perfection by Diversity.*—The *fons errorum* in M.

Comte's later speculations is this inordinate demand for "unity" and "systematization." This is the reason why it does not suffice to him that all should be ready, in case of need, to postpone their personal interests and inclinations to the requirements of the general good; he demands that each should regard as vicious any care at all for his personal interests, except as a means to the good of others—should be ashamed of it, should strive to cure himself of it, because his existence is not "systematized," is not in "complete unity," as long as he cares for more than one thing. The strangest part of the matter is that this doctrine seems to M. Comte to be axiomatic. That all perfection consists in unity, he apparently considers to be a maxim which no sane man thinks of questioning. It never seems to enter into his conceptions that any one could object *ab initio*, and ask why this universal systematizing, systematizing, systematizing? Why is it necessary that all human life should point but to one object, and be cultivated into a system of means to a single end? May it not be the fact that mankind, who, after all, are made up of single human beings, obtain a greater sum of happiness when each pursues his own, under the rules and conditions required by the good of the rest, than when each makes the good of the rest his only object, and allows himself no personal pleasures not indispensable to the preservation of his faculties? The regimen of a blockaded town should be cheerfully submitted to when high purposes require it, but is it the ideal perfection of human existence?—MILL *Positive Philosophy of Auguste Comte*, p. 127. (H. H. & Co., 1887.)

3530. UNITY, LOWER VS. HIGHER —*Position of Agnosticism.*—[The] fundamental inconsistency in the agnostic philosophy becomes all the more remarkable when we find that the very men who tell us that we are not one with anything above us are the same who insist that we are one with everything beneath us. Whatever there is in us or about us which is purely animal we may see everywhere; but whatever there is in us purely intellectual and moral we delude ourselves if we think we see it anywhere. There are abundant homologies between our bodies and the bodies of the beasts, but there are no homologies between our minds and any mind which lives and manifests itself in Nature. Our livers and our lungs, our vertebræ and our nervous systems, are identical in origin and in function with those of the living creatures round us: but there is nothing in Nature or above it which corresponds to our forethought, or design, or purpose—to our love of the good or our admiration of the beautiful—to our indignation with the wicked, or to our pity for the suffering and the fallen. I venture to think that no system of philosophy that has ever been taught on earth lies under such a weight of antecedent improbability; and this improbability increases in direct proportion to the success of science in tracing the unity of Nature, and in showing step by step how its laws and their results can be brought more and more into direct relation with the mind and intellect of man.—ARGYLL *Unity of Nature*, ch. 8, p. 166. (Burt.)

3531. UNITY OF ALL KNOWLEDGE —The truth is that there is no branch of human inquiry, however purely physical, which is more than the word "branch" implies; none which is not connected through endless ramifications with every other, and especially that which is the root and center of them all. If He who formed the mind be one with Him who is the Orderer of all things concerning which that mind is occupied, there can be no end to the points of contact between our different conceptions of them, of Him, and of ourselves.—ARGYLL *Reign of Law*, ch. 2, p. 35. (Burt.)

3532. UNITY OF LANGUAGE WRONGLY INFERRED—*History Told in Borrowed Words—Intercourse of Nations.*—Before now a writer has proved to his own satisfaction that Turkish, Arabic, and Persian are all branches of one primitive language, his argument being that the Turks call a man *adam*, as the Arabs call the first man, and a father *pader*, which is like the Persian word. The fact is true enough, but what the argument omits to notice is that the Turks have been for ages enriching their own barbaric language by taking words from the cultured Arabic and Persian, and *adam* and *pader* are such lately borrowed words, not philologically Turkish at all. Borrowed words like these are indeed valuable evidence, but what they prove is not the common origin of languages—it is intercourse between the nations speaking them. They often give the clew to the country from which some new produce was obtained, or some new instrument, or idea, or institution was learned. Thus in English it is seen by the very words how Italy furnished us with *opera*, *sonata*, *chiaroscuro*, while Spain gave *gallina* and *mulatto*; how from the Hebrews we have *sabbath* and *jubilee*, from the Arabs *zero* and *magazine*, while Mexico has supplied *chocolate* and *tomato*, Haiti *hammock* and *hurricane*, Peru *guano* and *quinin*, and even the languages of the South Sea Islands are represented by *taboo* and *tatoo*. But in all this there is not one particle of evidence that any one of these languages is sprung from the same family with any other.—TYLOR *Anthropology*, ch. 6, p. 154. (A., 1899.)

3533. UNITY OF MAN WITH LOWER NATURE—*A Beneficent Provision.*—It is because of the composition of our body that the animals and plants around us are capable of ministering to our support—that the common air is to us the very

breath of life, and that herbs and minerals in abundance have either poisoning properties or healing virtue.—ARGYLL *Unity of Nature*, ch. 2, p. 28. (Burt.)

3534. UNITY OF MANKIND—*Likeness, Mental and Bodily, of All Human Races.*—Now if, as some have thought, the negroes, Mongolians, whites, and other races were distinct species, each sprung from a separate origin in its own region, then the peopling of the globe might require only a moderate time, the races having only to spread each from its own birthplace. But the opinion of modern zoologists, whose study of the species and breeds of animals makes them the best judges, is against this view of several origins of man, for two principal reasons. First, that all tribes of men, from the blackest to the whitest, the most savage to the most cultured, have such general likeness in the structure of their bodies and the working of their minds as is easiest and best accounted for by their being descended from a common ancestry, however distant. Second, that all the human races, notwithstanding their form and color, appear capable of freely intermarrying and forming crossed races of every combination, such as the millions of mulattos and mestizos sprung in the New World from the mixture of Europeans, Africans, and native Americans; this again points to a common ancestry of all the races of man. We may accept the theory of the unity of mankind as best agreeing with ordinary experience and scientific research.—TYLOR *Anthropology*, ch. 1, p. 5. (A., 1899.)

3535. ——— ——— *Proof that Variety Is Consistent with Common Origin—Man's Command of the Whole Habitable Globe.*—I may refer the reader to the writings of Blumenbach, Prichard, Lawrence, and more recently Latham for convincing proofs that the varieties of form, color, and organization of different races of men are perfectly consistent with the generally received opinion that all the individuals of the species have originated from a single pair; and, while they exhibit in man as many diversities of a physiological nature as appear in any other species, they confirm also the opinion of the slight deviation from a common standard of which species are capable.

The power of existing and multiplying in every latitude, and in every variety of situation and climate, which has enabled the great human family to extend itself over the habitable globe, is partly, says Lawrence, the result of physical constitution, and partly of the mental prerogative of man. If he did not possess the most enduring and flexible corporeal frame, his arts would not enable him to be the inhabitant of all climates, and to brave the extremes of heat and cold and the other destructive influences of local situation. Yet, notwithstanding this flexibility of bodily frame, we find no signs of indefinite departure from a common standard, and the intermarriages of individuals of the most remote varieties are not less fruitful than between those of the same tribe.—LYELL *Principles of Geology*, bk. iii, ch. 36, p. 609. (A., 1854.)

3536. ——— ——— *The Crossing of Dissimilar Races.*—It may be strongly argued . . . that not only do the bodily and mental varieties of mankind blend gradually into one another, but that even the most dissimilar races can intermarry in all directions, producing mixed or sub-races which, when left to themselves, continue their own kind. Advocates of the polygenist theory, that there are several distinct races of man, sprung from independent origins, have denied that certain races, such as the English and native Australians, produce fertile half-breeds. But the evidence tends more and more to establish crossing as possible between all races, which goes to prove that all the varieties of mankind are zoologically of one species.—TYLOR *Anthropology*, ch. 3, p. 85. (A., 1899.)

3537. UNITY OF NATURE—[The] substitution or repetition of similar and almost identical forms, in regions that are separated from each other by seas or wide intervening tracts, is a wonderful law of Nature. It prevails even in the rarest forms of the floras.—HUMBOLDT *Views of Nature*, p. 317. (Bell, 1896.)

3538. ——— ——— *A Mental Conception—Theory of Development the Perception of a Plan.*—All theories of development have been simply attempts to suggest the manner in which or the physical process by means of which this ideal continuity of type and pattern has been preserved. But whilst all these suggestions have been in the highest degree uncertain, some of them violently absurd, the one thing which is certain is the fact for which they endeavor to account. And what is that fact? It is one which belongs to the world of mind, not to the world of matter. When Professor Owen tells us, for example, that certain jointed bones in the whale's paddle are the same bones which in the mole enable it to burrow, which in the bat enable it to fly, and in man constitute his hand, with all its wealth of functions, he does not mean that physically and actually they are the same bones, nor that they have the same uses, nor that they ever have been or ever can be transferable from one kind of animal to another. He means that in a purely ideal or mental conception of the plan of all vertebrate skeletons these bones occupy the same relative place—relative, that is, not to origin or use, but to the plan or conception of that skeleton as a whole.—ARGYLL *Reign of Law*, ch. 1, p. 19. (Burt.)

3539. ——— ——— *Apprehended by Savage—Recognition of One Great, Unseen Power.*—We find even among the most savage nations (as my own travels enable me

to attest) a certain vague, terror-stricken sense of the all-powerful unity of natural forces, and of the existence of an invisible, spiritual essence manifested in these forces, whether in unfolding the flower and maturing the fruit of the nutrient tree, in upheaving the soil of the forest, or in rending the clouds with the might of the storm. We may here trace the revelation of a bond of union, linking together the visible world and that higher spiritual world which escapes the grasp of the senses.—HUMBOLDT *Cosmos*, vol. i, int., p. 36. (H., 1897.)

3540. ——— ——— *Evaporation of Solids, as Ice and Metals.*—Metals, and probably all solids, evaporate at ordinary temperatures. It has long been known that ice evaporates very rapidly, and now it is found that metals do the same, and the evaporation can be detected at temperatures far below their melting-points. All these curious phenomena give us new ideas as to the constitution of matter, and lead us to the conclusion that the extreme mobility of the molecules of gases has its analogue in liquids and even in solids. The flow of metals, their diffusion into other metals, and their evaporation, lead to the conclusion that a proportion of their molecules must possess considerable mobility, and when these reach the surface they are enabled to escape either into other bodies in contact with them or into the atmosphere. This proportion of rapidly moving molecules gives to solids some of the characteristics of liquids and of gases.—WALLACE *The Wonderful Century*, ch. 7, p. 57. (D. M. & Co., 1899.)

3541. ——— ——— *Familiar Birds or Flowers in Strange Lands—Arctic Lichen under Shadow of Palm.*—In all regions, however far away from his own home, in the midst of a fauna and flora entirely new to him, the traveler is startled occasionally by the song of a bird or the sight of a flower so familiar that it transports him at once to woods where every tree is like a friend to him. It seems as if something akin to what in our own mental experience we call reminiscence or association existed in the workings of Nature; for tho the organic combinations are so distinct in different climates and countries, they never wholly exclude each other. Every zoological and botanical province retains some link which binds it to all the rest, and makes it part of the general harmony. The arctic lichen is found growing under the shadow of the palm on the rocks of the tropical sierra, and the song of the thrush and the tap of the woodpecker mingle with the sharp, discordant cries of the parrot and paroquet.—AGASSIZ *Geological Sketches*, ser. ii, p. 188. (H. M. & Co., 1896.)

3542. ——— ——— *Is Man an Exception?*—We have only to observe, in the first place, the strange and anomalous position in which it [*i. e.*, the assumption that in the system of Nature, as thus seen and known, there are no phenomena due to mind having any analogies with our own] places man. As regards at least the higher faculties of his mind, he is allowed no place in Nature, and no fellowship with any other thing or any other being outside of Nature. He is absolutely alone—out of all relation with the universe around him, and under a complete delusion when he sees in any part of it any mental homologies with his own intelligence, or with his own will, or with his own affections. Does this absolute solitariness of position as regards the higher attributes of man—does it sound reasonable, or possible, or consistent with some of the most fundamental conceptions of science? How, for example, does it accord with that great conception whose truth and sweep become every day more apparent—the unity of Nature?—ARGYLL *Unity of Nature*, ch. 8, p. 165. (Burt.)

3543. ——— ——— *Magnetism Apparently Universal as Gravitation.*—This process of unification of the cosmos . . . was carried no further until the fact unexpectedly emerged from a vast and complicated mass of observations, that the magnetism of the earth is subject to subtle influences, emanating, certainly, from some, and presumably . . . from all of the heavenly bodies; the inference being thus rendered at least plausible that a force not less universal than gravity itself, but with whose modes of operation we are as yet unacquainted, pervades the universe, and forms, it might be said, an intangible bond of sympathy between its parts. Now for the investigation of this influence two roads are open. It may be pursued by observation either of the bodies from which it emanates, or of the effects which it produces—that is to say, either by the astronomer or by the physicist, or, better still, by both concurrently. Their acquisitions are mutually profitable: nor can either be considered as independent of the other. Any important accession to knowledge respecting the sun, for example, may be expected to cast a reflected light on the still obscure subject of terrestrial magnetism: while discoveries in magnetism or its *alter ego* electricity must profoundly affect solar inquiries.—CLERKE *History of Astronomy*, pt. ii, ch. 1, p. 175. (Bl., 1893.)

3544. ——— ——— *Microscopic Revelations of Minutest Cell Join with Telescopic Study of Sun and Stars.*—To the scientific worker no subject is too vast for his research, no object so minute as to be unworthy of his most patient study. In some . . . inquiries concerning the nature of volcanic action we shall be led to an investigation of the phenomena displayed in the sun, moon, comets, and other great bodies of the universe; but another road to truths of the same grandeur and importance is found . . . in an examination of the

mode of development of crystallites, and a study of the materials contained in the microscopic cavities of the minutest crystals. —JUDD *Volcanoes*, ch. 3, p. 66. (A., 1899.)

3545. ——— ——— *One Plan in Structure of Diverse Animals—Leg and Jaw of Young Lobster Indistinguishable.*—[The] study of development proves that the doctrine of unity of plan is not merely a fancy, that it is not merely one way of looking at the matter, but that it is the expression of deep-seated, natural facts. The legs and jaws of the lobster may not merely be regarded as modifications of a common type—in fact and in Nature they are so—the leg and the jaw of the young animal being at first indistinguishable. — HUXLEY *Lay Sermons*, serm. 6, p. 101. (A., 1895.)

3546. ——— ——— *The Conservation of Energy—All Forces May Be One.*—It may be that all natural forces are resolvable into some one force; and indeed in the modern doctrine of the correlation of forces an idea which is a near approach to this has already entered the domain of science. It may also be that this one force, into which all others return again, is itself but a mode of action of the divine will. But we have no instruments whereby to reach this last analysis.—ARGYLL *Reign of Law*, ch. 3, p. 76. (Burt.)

3547. ——— ——— *The Kosmos.*—The system of Nature in which we live impresses itself on the mind as one system. It is under this impression that we speak of it as the "universe." It was under the same impression, but with a conception specially vivid of its order and its beauty, that the Greeks called it the "kosmos." By such words as these we mean that Nature is one whole—a whole of which all the parts are inseparably united—joined together by the most curious and intimate relations, which it is the highest work of observation to trace, and of reason to understand.—ARGYLL *Unity of Nature*, ch. 1, p. 1. (Burt.)

3548. ——— ——— *The One Great Lesson of Modern Science.*—What is the philosophic purport of these beautiful and sublime discoveries with which the keen insight and patient diligence of modern students of science are beginning to be rewarded? What is the lesson that is taught alike by the correlation of forces, by spectrum analysis, by the revelations of chemistry as to the subtle behavior of molecules inaccessible to the eye of sense, by the astronomy that is beginning to sketch the physical history of countless suns in the firmament, by the paleontology which is slowly unraveling the wonders of past life upon the earth through millions of ages? What is the grand lesson that is taught by all this? It is the lesson of the unity of Nature. To learn it rightly is to learn that all the things that we can see and know in the course of our life in this world are so intimately woven together that nothing could be left out without reducing the whole marvelous scheme to chaos.—FISKE *Through Nature to God*, pt. i, ch. 4, p. 23. (H. M. & Co., 1900.)

3549. UNITY OF ORIGIN OF EACH ORGANISM—*Distribution from a Single Center.*—The most important principle from which we must start in chorology, and of the truth of which we are convinced by due examination of the theory of selection, is that, as a rule, every animal and vegetable species has arisen only once in the course of time and only in one place on the earth —its so-called "center of creation"—by natural selection. I share this opinion of Darwin's unconditionally, in respect to the great majority of higher and perfect organisms, and in respect to most animals and plants in which the division of labor, or differentiation of the cells and organs of which they are composed, has attained a certain stage. For it is quite incredible, or could at best only be an exceedingly rare accident, that all the manifold and complicated circumstances—all the different conditions of the struggle for life which influence the origin of a new species by natural selection—should have worked together in exactly the same agreement and combination more than once in the earth's history, or should have been active at the same time at several different points of the earth's surface.—HAECKEL *History of Creation*, vol. i, ch. 14, p. 166. (K. P. & Co., 1899.)

3550. UNITY OF PERFECTION AND HAPPINESS—*Pleasure and Pain—Delight of Abundant Spontaneous Activity.*—Human perfection and human happiness coincide, and thus constitute, in reality, but a single end. For as, on the one hand, the perfection or full development of a power is in proportion to its capacity of free, vigorous, and continued action, so, on the other, all pleasure is the concomitant of activity; its degree being in proportion as that activity is spontaneously intense, its prolongation in proportion as that activity is spontaneously continued; whereas, pain arises either from a faculty being restrained in its spontaneous tendency to action, or from being urged to a degree, or to a continuance of energy beyond the limit to which it of itself freely tends. To promote our perfection is thus to promote our happiness; for to cultivate fully and harmoniously our various faculties is simply to enable them by exercise to energize longer and stronger without painful effort—that is, to afford us a larger amount of a higher quality of enjoyment.—HAMILTON *Metaphysics*, lect. 2, p. 15. (G. & L., 1859.)

3551. UNITY OF TENDENCY OF CERTAIN EPOCHS—*The Fifteenth Century in Discovery.*—The fifteenth century belongs to those remarkable epochs in which all the efforts of the mind indicate one determined

and general character, and one unchanging striving toward the same goal. The unity of this tendency, and the results by which it was crowned, combined with the activity of whole races, give to the age of Columbus, Sebastian Cabot, and Gama, a character both of grandeur and enduring splendor. In the midst of two different stages of human culture the fifteenth century may be regarded as a period of transition which belongs both to the Middle Ages and to the beginning of more recent times. It is the age of the greatest discoveries in space, embracing almost all degrees of latitude and all elevations of the earth's surface. While this period doubled the number of the works of creation known to the inhabitants of Europe, it likewise offered to the intellect new and powerful incitements toward the improvement of natural sciences, in the departments of physics and mathematics.—HUMBOLDT *Cosmos*, vol. ii, pt. ii, p. 228. (H., 1897.)

3552. UNITY OF THE SCIENCES—*Perhaps All Elements One—Alchemist's Dream May Come True.*—Every important discovery establishes a closer kinship between the sciences. The time has already come when to know any one of the sciences thoroughly it is necessary to know the rest: in fact, all the so-called natural sciences are different branches of one great science. It is doubtless true that there is but one energy, and it may be that there is but one element of matter out of which all the various so-called elements come.—ELISHA GRAY *Nature's Miracles*, vol. ii, ch. 20, p. 170. (F. H. & H., 1900.)

3553. UNITY OF THE UNIVERSE—It is every day becoming more and more clear that our earth is bound by ties of the closest resemblance to the other members of that family of worlds to which it belongs, and that the materials entering into their constitution and the forces operating in all are the same. . . . There are the strongest grounds for believing the interior of our globe to consist of similar materials to those found in the small planetary bodies known as meteorites. That the comets are merely aggregations of such meteorites, and that the planets differ from them only in their greater dimensions, may be regarded as among the demonstrated conclusions of the astronomer. The materials found most abundantly in meteorites and in the interior of our globe are precisely the same as those which are proved to exist in an incandescent state in our sun. Hence we are led to conclude that the whole of the bodies of the solar system are composed of the same chemical elements.—JUDD *Volcanoes*, ch. 12, p. 360. (A., 1899.)

3554. ——— ——— *Continuity of the Law of Gravitation through All Worlds.*—The most striking examples of the continuousness of law are, perhaps, those furnished by astronomy, especially in connection with the more recent applications of spectrum analysis. But even in the case of the simpler laws the demonstration is complete. There is no reason apart from continuity to expect that gravitation, for instance, should prevail outside our world. But wherever matter has been detected throughout the entire universe, whether in the form of star or planet, comet or meteorite, it is found to obey that law. "If there were no other indication of unity than this it would be almost enough. For the unity which is implied in the mechanism of the heavens is indeed a unity which is all-embracing and complete. The structure of our own bodies, with all that depends upon it, is a structure governed by and therefore adapted to the same force of gravitation which has determined the form and the movements of myriads of worlds. Every part of the human organism is fitted to conditions which would all be destroyed in a moment if the forces of gravitation were to change or fail.—DRUMMOND *Natural Law in the Spiritual World*, p. 36. (H. Al.)

3555. ——— ——— *Earthly Elements Found in Far-off Stars—Aldebaran.*—The light of this star [Aldebaran] is of a pale red. Seen in the spectroscope it presents at a glance a great number of strong lines, particularly in the orange, green, and blue. The positions of about seventy of these lines have been measured, and coincidences have been found with the spectra of *sodium, magnesium, hydrogen, calcium, iron, bismuth, tellurium, antimony,* and *mercury.* Seven other elements have been compared with this star, namely—*nitrogen, cobalt, tin, lead, cadmium, lithium,* and *barium;* but no coincidence has been observed.—FLAMMARION *Popular Astronomy*, bk. vi, ch. 6, p. 608. (A.)

3556. ——— ——— *Gravitation Holds through Boundless Space.*—In the front rank of all . . . is the law of gravitation. The celestial bodies, as you all know, float and move in infinite space. Compared with the enormous distances between them, each of us is but as a grain of dust. The nearest fixed stars, viewed even under the most powerful magnification, have no visible diameter: and we may be sure that even our sun, looked at from the nearest fixed stars, would only appear as a single luminous point, seeing that the masses of those stars, in so far as they have been determined, have not been found to be materially different from that of the sun. But, notwithstanding these enormous distances, there is an invisible tie between them which connects them together, and brings them in mutual interdependence. This is the force of gravitation with which all heavy masses attract each other. We know this force as gravity when it is operative between an earthly body and the mass of our earth. The force which causes a body to fall to the ground is none other than that which continually

compels the moon to accompany the earth in its path round the sun, and which keeps the earth itself from fleeing off into space, away from the sun.—HELMHOLTZ *Popular Lectures,* lect. 4, p. 145. (L. G. & Co., 1898.)

3557. ——— ——— *Laws of Gravitation and of Chemistry the Same through Farthest Space.*—That a science of stellar chemistry should not only have become possible, but should already have made material advances, is assuredly one of the most amazing features in the swift progress of knowledge our age has witnessed. Custom can never blunt the wonder with which we must regard the achievement of compelling rays emanating from a source devoid of sensible magnitude through immeasurable distance, to reveal, by its peculiarities, the composition of that source. The discovery of revolving double stars assured us that the great governing force of the planetary movements, and of our own physical existence, sways equally the courses of the farthest suns in space; the application of prismatic analysis certified to the presence in the stars of the familiar materials, no less of the earth we tread, than of the human bodies built up out of its dust and circumambient vapors.—CLERKE *History of Astronomy,* pt. ii, ch. 12, p. 450. (Bl., 1893.)

3558. ——— ——— *Sodium Found in Spectrum of a Comet.*—Comet Wells [in its circuit], approached its [the sun's] surface within little more than five million miles on June 10, 1882; and it is not doubtful that to this circumstance the novel feature in its incandescence was due. During the first half of April its spectrum was of the normal type, tho the carbon bands were unusually weak; but with increasing vicinity to the sun they died out, and the entire light seemed to become concentrated into a narrow, unbroken, brilliant streak, hardly to be distinguished from the spectrum of a star. This unusual behavior excited attention, and a strict watch was kept. It was rewarded at the Dunecht Observatory, May 27, by the discernment of what had never before been seen in a comet—the yellow ray of sodium. By June 1 this had kindled into a blaze overpowering all other emissions. The light of the comet was practically monochromatic; and the image of the entire head, with the root of the tail, could be observed, like a solar prominence, depicted, in its new saffron vesture of vivid illumination, within the jaws of an open slit.—CLERKE *History of Astronomy,* pt. ii, ch. 11, p. 431. (Bl., 1893.)

3559. UNITY, VISIBLE AND TANGIBLE—*Luminiferous Ether a Solid—The Crystalline Orb of Poetry.*—Sir J. Herschel has declared that the luminiferous ether must be conceived of not as an air, nor as a fluid, but rather as a solid—"in this sense, at least, that its particles cannot be supposed as capable of interchanging places, or of bodily transfer to any measurable distance from their own special and assigned localities in the universe." Well may Sir J. Herschel add that "this will go far to realize (in however unexpected a form) the ancient idea of a crystalline orb." And thus the wonderful result of all investigation is that this earth is in actual rigid contact with the most distant worlds in space—in rigid contact, that is to say, through a medium which touches and envelops all, and which is incessantly communicating from one world to another the minutest vibrations it receives.—ARGYLL *Unity of Nature,* ch. 1, p. 8. (Burt.)

3560. UNIVERSALITY OF DEEP-SEA LIFE—*No Part of the Ocean Azoic.*—As soon as it became clear to naturalists that there is no part of the ocean, however deep it may be, that deserves the name "azoic," but that almost every part has a fauna of greater or less density, the problem of the origin of this fauna presented itself.—HICKSON *Fauna of the Deep Sea,* ch. 3, p. 53. (A., 1894.)

3561. UNIVERSALITY OF EMULATION—*Affects Even Religion (2 Cor. ix, 2-4).*—Emulation or rivalry, a very intense instinct, [is] especially rife with young children, or at least especially undisguised. Every one knows it. Nine-tenths of the work of the world is done by it. We know that if we do not do the task some one else will do it and get the credit; so we do it. It has very little connection with sympathy, but rather more with pugnacity.—JAMES *Psychology,* vol. ii, ch. 24, p. 409. (H. H. & Co., 1899.)

3562. UNIVERSE, ANCIENT IDEA OF THE—*Cicero's Scheme as Given in the "Dream of Scipio"—Hearing Blunted by Harmony.*—The universe is composed of nine circles, or rather of nine globes, which move. The external sphere is that of the sky, which includes all the others, and on which are fixed the stars. Within revolve seven globes, drawn along by a motion contrary to that of the sky. On the first circle revolves the star which men call Saturn; on the second moves Jupiter, a star beneficent and propitious to human beings; then comes Mars, glowing and abhorred; below, occupying the middle region, shines the sun, chief, prince, moderator of the other stars, life of the world, whose immense globe illuminates and fills the volume of its light. After him come, like two companions, Venus and Mercury. Finally, the lower orbit is occupied by the moon, which borrows its light from the day-star. Below this last celestial circle there is nothing but mortal and corruptible, with the exception of the souls given by divine kindness to the human race. Above the moon all is eternal. Our earth, placed at the center of the world, and separated from the sky in all directions, remains motionless, and all heavy bodies are drawn towards it by their own weight.

Formed of unequal intervals, but combined according to a correct proportion, harmony results from the motion of the sphere, which, forming grave and high tones in a common accord, makes with all these varied notes a melodious concert. Such grand motions cannot be accomplished in silence, and Nature has placed a grave tone at the slow and inferior orbit of the moon, and a high tone at the superior and rapid orbit of the starry firmament; with these two limits of the octave, the eight moving globes produce seven tones in different ways, and this number is the bond of all things in general. The ears of men filled with this harmony know not how to hear it, and mortals do not possess a more imperfect sense. It is thus that the tribes near the Cataracts of the Nile have lost the power of hearing them. The splendid concert of the whole universe in its rapid revolution is so prodigious that your ears are closed to this harmony, as your glances sink before the fires of the sun, whose piercing light dazzles and blinds you.—FLAMMARION *Popular Astronomy*, bk. iv, ch. 1, p. 332. (A.)

3563. UNIVERSE DIVIDED DIFFERENTLY BY EACH INDIVIDUAL— *"Me" and "Not-me."*—There is . . . one entirely extraordinary case in which no two men ever are known to choose alike. One great splitting of the whole universe into two halves is made by each of us; and for each of us almost all of the interest attaches to one of the halves; but we all draw the line of division between them in a different place. When I say that we all call the two halves by the same names, and that those names are "me" and "not-me" respectively, it will at once be seen what I mean. The altogether unique kind of interest which each human mind feels in those parts of creation which it can call me or mine may be a moral riddle, but it is a fundamental psychological fact. No mind can take the same interest in his neighbor's me as in his own. . . . Each of us dichotomizes the cosmos in a different place.—JAMES *Psychology*, vol. i, ch. 9, p. 289. (H. H. & Co., 1899.)

3564. UNIVERSE EVANESCENT— *Its Energy at Last Expended—Science Has No Prophecy Beyond—"They All Shall Grow Old as a Garment, and as a Vesture Shalt Thou Change Them, and They Shall Be Changed" (Ps. cii, 26).*—We are dependent upon the sun and center of our system, not only for the mere energy of our frames, but also for our delicacy of construction—the future of our race depends upon the sun's future. But we have seen that the sun must have had a beginning, and that he will have an end. We are thus induced to generalize still further, and regard, not only our own system, but the whole material universe, when viewed with respect to serviceable energy, as essentially evanescent, and as embracing a succession of physical events which cannot go on forever as they are. But here at length we come to matters beyond our grasp; for physical science cannot inform us what must have been before the beginning, nor yet can it tell us what will take place after the end.—STEWART *Conservation of Energy*, ch. 6, p. 414. (Hum., 1880.)

3565. UNIVERSE, MECHANICAL THEORY OF THE— *Laplace's Nebular Hypothesis—Change of View from Eighteenth to Nineteenth Century.*—[Laplace's] scheme of cosmical evolution was a characteristic bequest of the eighteenth century to the nineteenth. It possessed the self-sufficing symmetry and entireness appropriate to the ideas of a time of renovation, when the complexity of Nature was little accounted of in comparison with the imperious orderliness of the thoughts of man. Since it was propounded, however, knowledge has transgressed many boundaries, and set at naught much ingenious theorizing. How has it fared with Laplace's sketch of the origin of the world? It has at least not been discarded as effete. The groundwork of speculation on the subject is still furnished by it. It is, nevertheless, admittedly inadequate. Of much that exists it gives no account, or an erroneous one. The march of events certainly did not everywhere—even if it did anywhere—follow the exact path prescribed for it. Yet modern science attempts to supplement, but scarcely ventures to supersede it.—CLERKE *History of Astronomy*, pt. ii, ch. 9, p. 375. (Bl., 1893.)

3566. UNIVERSE NOT MERELY MATTER AND FORCE— *Contains at Least One Rational and Conscious Being.*—The universe does not consist merely of insensate matter and force and automatic vitality: there happens to be in it the rational and consciously responsible being, man.—DAWSON *Facts and Fancies in Modern Science*, lect. 1, p. 27. (A. B. P. S.)

3567. UPLIFTING, GRADUAL, OF CONTINENTS— *Rise of a Century Measured by Inches.*—Perhaps it may be said that there is no analogy between the slow upheaval of broad plains or table-lands and the manner in which we must presume all mountain chains, with their inclined strata, to have originated. It seems, however, that the Andes have been rising century after century, at the rate of several feet, while the pampas on the east have been raised only a few inches in the same time. Crossing from the Atlantic to the Pacific, in a line passing through Mendoza, Mr. Darwin traversed a plain 800 miles broad, the eastern part of which has emerged from beneath the sea at a very modern period. The slope from the Atlantic is at first very gentle, then greater, until the traveler finds, on reaching Mendoza, that he has gained, almost insensibly, a height of 4,000 feet. The mountainous district then begins suddenly, and its breadth from Mendoza to the

shores of the Pacific is 120 miles, the average height of the principal chain being from 15,000 to 16,000 feet, without including some prominent peaks, which ascend much higher. Now all we require, to explain the origin of the principal inequalities of level here described, is to imagine, first, a zone of more violent movement to the west of Mendoza, and, secondly, to the east of that place, an upheaving force, which died away gradually as it approached the Atlantic. In short, we are only called upon to conceive that the region of the Andes was pushed up four feet in the same period in which the pampas near Mendoza rose one foot, and the plains near the shores of the Atlantic one inch. In Europe we have learned that the land at the North Cape ascends about five feet in a century, while farther to the south the movements diminish in quantity first to a foot, and then, at Stockholm, to three inches in a century, while at certain points still farther south there is no movement.—Lyell *Principles of Geology*, bk. i, ch. 1, p. 171. (A., 1854.)

3568. UPROAR OF LIFE IN TROPICAL FOREST—*Profusion of Nature Made Audible—Stillness in England Deathlike by Contrast.*—As we continued our walk the brief twilight commenced, and the sounds of multifarious life came from the vegetation around. The whirring of cicadas; the shrill stridulation of a vast number and variety of field crickets and grasshoppers, each species sounding its peculiar note; the plaintive hooting of tree-frogs—all blended together in one continuous ringing sound—the audible expression of the teeming profusion of Nature. As night came on, many species of frogs and toads in the marshy places joined in the chorus; their croaking and drumming, far louder than anything I had before heard in the same line, being added to the other noises, created an almost deafening din. This uproar of life, I afterward found, never wholly ceased, night or day: in course of time I became, like other residents, accustomed to it. It is, however, one of the peculiarities of a tropical—at least a Brazilian—climate which is most likely to surprise a stranger. After my return to England, the deathlike stillness of summer days in the country appeared to me as strange as the ringing uproar did on my first arrival at Pará.—Bates *Naturalist on the Amazon*, ch. 1, p. 625. (Hum., 1880.)

3569. USE AND ORNAMENT CONNECTED—*Curves of Movement Are Forms of Beauty.*—The harmonies on which all beauty probably depends are so minutely connected in Nature that use and ornament may often both arise out of the same conditions. Thus, some of the most beautiful lines on the surface of shells are simply the lines of their annual growth, which growth has followed definite curves, and it is the law of these curves that is beautiful in our eyes. Again, the forms of many fish which are so beautiful are also forms founded on the lines of least resistance. The same observation applies to the form of the bodies and of the wings of birds. Throughout Nature ornament is perpetually the result of conditions and arrangements fitted to use and contrived for the discharge of function. But the same principle applies to human art, and few persons are probably aware how many of the mere ornaments of architecture are the traditional representation of parts which had their origin in essential structure. Yet who would argue from this fact that ornament is not a special aim in the works of man? When the savage carves the handle of his war-club the immediate purpose of his carving is to give his own hand a firmer hold. But any shapeless scratches would be enough for this. When he carves it in an elaborate pattern he does so for the love of ornament, and to satisfy the sense of beauty.—Argyll *Reign of Law*, ch. 4, p. 115. (Burt.)

3570. USEFULNESS OF THE CROW—*An Insectivorous Bird—High Intelligence of the Corvidæ.*—There are systematists who think that the members of this family [the *Corvidæ*, including crows, jays, etc.] should hold the place usually assigned the thrushes, at the head of the class *Aves* [birds]. Leaving out of the case anatomical details whose value is disputed, we might object to a family of songless birds being given first rank in a group whose leading character is power of song. But while crows and jays may from a musical standpoint be considered songless, no one can deny their great vocal powers. Song, after all, does not imply high rank in bird-life. . . . . If, however, the relative intelligence . . . be taken into account, there can be no doubt that the *Corvidæ* fully deserve to be considered the most highly developed of birds. . . .

Crows share with hawks the reputation of being harmful birds. That they do much damage in the corn field is undeniable, but, after the examination of nine hundred crows' stomachs, Dr. Merriam, of the Department of Agriculture, states that the amount of good done by the crow in destroying grasshoppers, May-beetles, cutworms, and other injurious insects exceeds the loss caused by the destruction of corn. Moreover, if the corn be tarred before planting, the crows will not touch either the kernel or young sprout.—Chapman *Bird-Life*, ch. 7, p. 161. (A., 1900.)

3571. USES OF DARKNESS—*Fraunhofer's Lines Give New Meaning to the Spectrum.*—The gaseous spectra present a different appearance when the gas is in front of an ignited solid whose temperature is far higher than that of the gas. The observer sees then a continuous spectrum of a solid, but traversed by fine dark lines, which are just visible in the places in which the gas alone, seen in front of a dark background, would show bright lines. The solar spec-

trum is of this kind, and also that of a great number of fixed stars. The dark lines of the solar spectrum, originally discovered by Wollaston, were first investigated and measured by Fraunhofer, and are hence known as Fraunhofer's lines.—HELMHOLTZ *Popular Lectures*, lect. 4, p. 153. (L. G. & Co., 1898.)

3572. UTILITARIANISM COMMENDABLE—*The End the Measure of the Utility.*—What is a utilitarian? Simply one who prefers the useful to the useless—and who does not? But what is the useful? That which is prized, not on its own account, but as conducive to the acquisition of something else—the useful is, in short, only another word for a mean towards an end; for every mean is useful, and whatever is useful is a mean. Now the value of a mean is always in proportion to the value of its end; and the useful being a mean, it follows that, of two utilities, the one which conduces to the more valuable end will be itself the more valuable utility.

So far there is no difference of opinion. All agree that the useful is a mean towards an end; and that, *cæteris paribus*, a mean towards a higher end constitutes a higher utility than a mean towards a lower. The only dispute that has arisen or can possibly arise in regard to the utility of means (supposing always their relative efficiency) is founded on the various views that may be entertained in regard to the existence and comparative importance of ends.—HAMILTON *Metaphysics*, lect. 1, p. 3. (G. & L., 1859.)

3573. UTILITY AND INUTILITY OF FEAR—In fact, the teleology of fear, beyond a certain point, is very dubious. Professor Mosso, in his interesting monograph, "La Paura" (which has been translated into French), concludes that many of its manifestations must be considered pathological rather than useful; Bain, in several places, expresses the same opinion; and this, I think, is surely the view which any observer without a priori prejudices must take. A certain amount of timidity obviously adapts us to the world we live in, but the fear-paroxysm is surely altogether harmful to him who is its prey.—JAMES *Psychology*, vol. ii, ch. 24, p. 419. (H. H. & Co., 1899.)

3574. UTILITY AND PROGRESS—*Key of the Baconian Philosophy—Ancient Philosophy Despised the Practical.*—Two words form the key of the Baconian doctrine — utility and progress. The ancient philosophy disdained to be useful, and was content to be stationary. It dealt largely in theories of moral perfection, which were so sublime that they never could be more than theories; in attempts to solve insoluble enigmas; in exhortations to the attainment of unattainable frames of mind. It could not condescend to the humble office of ministering to the comfort of human beings. All the schools regarded that office as degrading; some censured it as immoral. Once indeed Posidonius, a distinguished writer of the age of Cicero and Cæsar, so far forgot himself as to enumerate among the humbler blessings which mankind owed to philosophy the discovery of the principle of the arch and the introduction of the use of metals. This eulogy was considered as an affront, and was taken up with proper spirit. Seneca vehemently disclaims these insulting compliments. Philosophy, according to him, has nothing to do with teaching men to rear arched roofs over their heads. The true philosopher does not care whether he has an arched roof or any roof. Philosophy has nothing to do with teaching men the use of metals. She teaches us to be independent of all material substances, of all mechanical contrivances. The wise man lives according to Nature. Instead of attempting to add to the physical comforts of his species, he regrets that his lot was not cast in that golden age when the human race had no protection against the cold but the skins of wild beasts, no screen from the sun but a cavern. To impute to such a man any share in the invention or improvement of a plow, a ship, or a mill is an insult.—MACAULAY *Essays (Lord Bacon)*, p. 271. (A., 1876.)

3575. UTILITY COMBINED WITH BEAUTY—*Palms, Bananas, and Ferns.*—Palms, bananas, and arborescent ferns constitute three forms of especial beauty peculiar to every portion of the tropical zone; wherever heat and moisture cooperate, vegetation is most exuberant and vegetable forms present the greatest diversity. Hence South America is the most beautiful portion of the palm world. . . . In the basin of the Orinoco whole tribes find the means of subsistence for many months together in the fruit of the palm.—HUMBOLDT *Views of Nature*, p. 303. (Bell, 1896.)

3576. UTILITY COMPELS EXACTNESS—*Practical Results To Be Won or Lost—Mere Disputation Content with Unproved Premises.*—By stimulating men to the discovery of new truth Bacon stimulated them to employ the inductive method, the only method—even the ancient philosophers and the schoolmen themselves being judges—by which new truth can be discovered. By stimulating men to the discovery of useful truth he furnished them with a motive to perform the inductive process well and carefully. His predecessors had been anticipators of Nature. They had been content with first principles, at which they had arrived by the most scanty and slovenly induction. And why was this? It was, we conceive, because their philosophy proposed to itself no practical end, because it was merely an exercise of the mind. A man who wants to contrive a new machine or a new medicine has a strong motive to observe accurately and patiently, and to try experiment after experiment. But a man who merely wants

a theme for disputation or declamation has no such motive. He is therefore content with premises grounded on assumption, or on the most scanty and hasty induction. Thus, we conceive, the schoolmen acted. On their foolish premises they often argued with great ability; and as their object was "*assensum subjugare, non res*"—to be victorious in controversy, not to be victorious over Nature—they were consistent. For just as much logical skill could be shown in reasoning on false as on true premises. But the followers of the new philosophy, proposing to themselves the discovery of useful truth as their object, must have altogether failed of attaining that object if they had been content to build theories on superficial induction.—MACAULAY *Essays (Lord Bacon)*, p. 283. (A., 1876.)

3577. UTILITY, DISCOVERY OF UNEXPECTED—*Nature Sifts the Food of Insectivorous Plants—Marginal Spikes of Venus's Fly-trap—Escape of Useless Insects Provided for.*—We are now prepared to understand the use of the marginal spikes which form so conspicuous a feature in the appearance of the plant [*Dionæa muscipula*, or Venus's fly-trap], and which at first seemed to me in my ignorance useless appendages. From the inward curvature of the lobes as they approach each other the tips of the marginal spikes first intercross, and ultimately their bases. Until the edges of the lobes come into contact, elongated spaces between the spikes, varying from the $\frac{1}{15}$ to the $\frac{1}{10}$ of an inch (1.693 to 2.54 mm.) in breadth, according to the size of the leaf, are left open. Thus an insect, if its body is not thicker than these measurements, can easily escape between the crossed spikes, when disturbed by the closing lobes and increasing darkness; and one of my sons actually saw a small insect thus escaping. A moderately large insect, on the other hand, if it tries to escape between the bars, will surely be pushed back again into its horrid prison with closing walls, for the spikes continue to cross more and more until the edges of the lobes come into contact. . . . Now it would manifestly be a great disadvantage to the plant to waste many days in remaining clasped over a minute insect, and several additional days or weeks in afterwards recovering its sensibility, inasmuch as a minute insect would afford but little nutriment. It would be far better for the plant to wait for a time until a moderately large insect was captured, and to allow all the little ones to escape; and this advantage is secured by the slowly intercrossing marginal spikes, which act like the large meshes of a fishing-net, allowing the small and useless fry to escape.—DARWIN *Insectivorous Plants*, ch. 13, p. 252. (A., 1900.)

3578. UTILITY, ENDEAVOR TO ATTAIN—*Magnetism Converted into Electricity—Faraday's Words.*—Faraday's reply to those who saw nothing gained by the development of the little [electric] spark, and who demanded its utility, was . . . sententious. "Endeavor to make it useful," he said. He left to others the immediate work of doing so. Some twenty-five years later he saw that tiny flash expanded into the magnificent blaze of the famous South Foreland lighthouse. To-day it illuminates the thoroughfares of the great cities of the civilized world.—PARK BENJAMIN *Age of Electricity*, ch. 7, p. 90. (S., 1897.)

3579. UTILITY, HIGHER AND LOWER—*Knowledge for the Sake of Man—Means Valued in Proportion to End.*—There are few, I believe, disposed to question the speculative dignity of mental science; but its practical utility is not unfrequently denied. To what, it is asked, is the science of mind conducive? What are its uses? I am not one of those who think that the importance of a study is sufficiently established when its dignity is admitted; for, holding that knowledge is for the sake of man, and not man for the sake of knowledge, it is necessary, in order to vindicate its value, that every science should be able to show what are the advantages which it promises to confer upon its student. I, therefore, profess myself a utilitarian; and it is only on the special ground of its utility that I would claim for the philosophy of mind what I regard as its peculiar and preeminent importance.—HAMILTON *Metaphysics*, lect. 1, p. 3. (G. & L., 1859.)

3580. UTILITY MORE THAN BEAUTY—*Classic Lamps—The Argand Burner.*—The Greek and Roman lamps, tho in beautiful receptacles of bronze or silver, were exactly the same in principle as those of the lowest savage, and hardly better in light-giving power; and tho various improvements in form were introduced, the first really important advance was made by the Argand burner. This introduced a current of air into the center of the flame as well as outside it, and, by means of a glass chimney, a regular supply of air was kept up, and a steady light produced. Altho the invention was made at the end of the last century, the lamps were not sufficiently improved and cheapened to come into use till about 1830; and from that time onward many other improvements were made, chiefly dependent on the use of the cheap mineral oils, rendering lamps so inexpensive, and producing so good a light that they are now found in the poorest cottages.—WALLACE *The Wonderful Century*, ch. 4, p. 28. (D. M. & Co., 1898.)

3581. UTILITY NOT THE SUPREME TEST—*Life a Power beyond Man's Measure of Use.*—After all, is this question of "use" really one which need concern us greatly in our studies of life? I trow not; for it surely indicates by no means a lofty conception of things if we are perpetually to

speak and think of living beings as we should talk of the items in a store. Each organism, like the smith in "The Fair Maid of Perth," fights for its own hand in the struggle for existence. If in the course of its fight it aids or opposes the interests of other living things it will receive benefit or incur failure in a meed corresponding to its own ways and means. This is really the true philosophy of natural history study. To "consider the lilies" as if they were mere contrivances for human ends and "uses" is a tolerably small-minded fashion of regarding the children of life. To know something of their histories, structure, and relationships, and thereby to learn how life jogs along its primrose way (or the reverse), is in itself an education worth much seeking-after and much painstaking care.—WILSON *Glimpses of Nature*, ch. 1, p. 7. (Hum., 1892.)

3582. ——— *Truth an End for Itself—Unexpected Utility Results.*—If you ask me, To what end?—of what use is such a discovery?—I answer, It is given to no mortal man to predict what may be the result of any discovery in the realms of Nature. When the electric current was discovered, what was it? A curiosity. When the first electric machine was invented, to what use was it put? To make puppets dance for the amusement of children. To-day it is the most powerful engine of civilization. But should our work have no other result than this—to know that certain facts in Nature are thus and not otherwise, that their causes were such and no others—this result in itself is good enough, and great enough, since the end of man, his aim, his glory, is the knowledge of the truth.—AGASSIZ *Journey in Brazil*, ch. 3, p. 95. (H. M. & Co., 1896.)

3583. UTILITY OF DIVERGENCE—*A Maximum of Organic Forms in Each Area.*—Divergence of character has a double purpose and use. In the first place it enables a species which is being overcome by rivals, or is in process of extinction by enemies, to save itself by adopting new habits or by occupying vacant places in Nature. This is the immediate and obvious effect of all the numerous examples of divergence of character which we have pointed out. But there is another and less obvious result, which is that the greater the diversity in the organisms inhabiting a country or district the greater will be the total amount of life that can be supported there.—WALLACE *Darwinism*, ch. 5, p. 77. (Hum.)

3584. UTILITY OF MICRO-ORGANISMS—*Bacteria Useful as Well as Harmful—Saprophytes and Parasites.*—A *saprophyte* is an organism that obtains its nutrition from dead organic matter. Its services, of whatever nature, lie outside the tissues of living animals. Its life is spent apart from a "host." A *parasite*, on the other hand, lives always at the expense of some other organism which is its host, in which it lives and upon which it lives. There is a third or intermediate group, known as "facultative," owing to their ability to act as parasites or saprophytes, as the exigencies of their life-history may demand.

The saprophytic organisms are, generally speaking, those which contribute most to the benefit of man, and the parasitic the reverse, tho this statement is only approximately true. In their relation to the processes of fermentation, decomposition, nitrification, etc., we shall see how great and invaluable is the work which saprophytic microbes perform. [See DECOMPOSITION, BACTERIA OF.]—NEWMAN *Bacteria*, ch. 1, p. 27. (G. P. P., 1899.)

3585. UTILITY SUBLIMATED TO USELESSNESS—*Humanity Not Guided by the Inconceivable.*—So long as the simple and natural meaning was put upon utility, and the good was identified with the pleasurable, or the serviceable, the utilitarian theory of morals did indicate at least some rule of life, however low that rule might be. But now that the apostles of that theory have been driven to put upon utility a transcendental meaning, and the pleasurable is interpreted to refer not merely to the immediate and visible effects of conduct on ourselves or others, but to its remotest effects upon all living beings, both now and for all future time, the utilitarian theory in this very process of sublimation becomes lifted out of the sphere of human judgment. If it be true "that there can be no correct idea of a part without a correct idea of the correlative whole," and if human conduct in its tendencies and effects is only "a part of universal conduct"—that is to say, of the whole system of the universe in its past, its present, and its future—then, as this whole is beyond all our means of knowledge and comprehension, it follows that utility, in this sense, can be no guide to us.—ARGYLL *Unity of Nature*, ch. 9, p. 208. (Burt.)

3586. UTILITY, UNEXPECTED—*Conspicuous Coloring Protective—Zebra Almost Invisible in Twilight.*—It may be thought that such extremely conspicuous markings as those of the zebra would be a great danger in a country abounding with lions, leopards, and other beasts of prey; but it is not so. Zebras usually go in bands, and are so swift and wary that they are in little danger during the day. It is in the evening or on moonlight nights, when they go to drink, that they are chiefly exposed to attack; and Mr. Francis Galton, who has studied these animals in their native haunts, assures me that in twilight they are not at all conspicuous, the stripes of white and black so merging together into a gray tint that it is very difficult to see them at a little distance. We have here an admirable illustration of how a glaringly conspicuous style of marking for recog-

nition may be so arranged as to become also protective at the time when protection is most needed; and we may also learn how impossible it is for us to decide on the inutility of any kind of coloration without a careful study of the habits of the species in its native country.—WALLACE *Darwinism*, ch. 8, p. 149. (Hum.)

3587. ——— ——— *Scientific Toy Gives Roentgen Rays.*—There are thousands of facts which are discovered which seem to have no interest, near or remote, to the welfare of humanity, and yet the discovery and recording of these facts must sometime and somehow prove useful.

In chemistry we have many illustrations of this idea. Many years ago Professor Crookes, by producing a vacuum far greater than had ever been accomplished before, discovered certain properties of energy which he called radiant matter. For nearly twenty years Crookes' tubes have been a physical toy devoted more to the entertainment than the instruction of classes in light, heat, and electricity. The vanes of mica, blackened on one side, and revolving without any apparent cause, seem to be almost a realization of the chimera of perpetual motion. With wonderful skill and ingenuity Professor Crookes investigated the elusive properties of this fourth state of matter, a space from which almost all energy was excluded, save that of the unthinkable ether itself. Who, even a few months ago, would have supposed that these truly marvelous researches of Crookes could possibly have any direct influence upon men and things? Yet we see now through the marvelous discovery of Professor Roentgen an application of Professor Crookes's discovery which, in its possibilities of benefit to suffering humanity, has not been surpassed by any single invention of the last hundred years.—WILEY *Relations of Chemistry to Industrial Progress (Address at Purdue University, Lafayette, Ind., 1896*, p. 18).

3588. UTILIZATION OF WASTE PRODUCTS—*Bleaching-powder Made to Lock Up Noxious Gas.*—Formerly the chemist when he wished to obtain sodium extracted it from common salt and discharged the chlorin gas into the air. It was found that in establishments where the manufacture of sodium was conducted on a large scale the destructive properties of the chlorin discharged into the air were such that all vegetation was killed for some distance around the manufactory. This came to be such a nuisance that the manufacturers were either compelled to stop business or in some way take care of the chlorin. This is done at the present day by uniting the chlorin gas with common lime, forming a chlorid of lime, which is used for bleaching and purifying purposes.—ELISHA GRAY *Nature's Miracles*, vol. i, ch. 5, p. 37. (F. H. & H., 1900.)

3589. ——— ——— *Colors from Coal-tar.*—Through the discoveries of the great Hoffmann and afterwards by the investigations of other chemists, the dyeing interests of the world have been completely revolutionized. From that most unpromising substance, coal-tar, at one time considered an almost worthless residue of the manufacture of gas, nearly all the colors which now find a use in the arts have been derived.—WILEY *Relations of Chemistry to Industrial Progress (Address at Purdue University, Lafayette, Ind., 1896*, p. 17).

3590. VAGARIES, PHILOSOPHICAL, OF SCIENTISTS—*Importations of Theories into Scripture—Imagined "Conflict of Religion and Science."*—One fruitful cause of difficulty in the relations of science and religion is to be found in the narrowness and incapacity of well-meaning Christians who unnecessarily bring the doctrines of natural and revealed religion into conflict, by misunderstanding the one or the other, or by attaching obsolete scientific ideas to Holy Scripture, and identifying them with it in points where it is quite non-committal. Much mischief is also done by a prevalent habit of speaking of all, or nearly all, the votaries of science as if they were irreligious. A second cause is to be found in the extravagant speculations indulged in by the adherents of certain philosophical systems. Such speculations often far overpass the limits of actual scientific knowledge, and are yet paraded before the ignorant as if they were legitimate results of science, and so become irretrievably confounded with it in the popular mind.—DAWSON *Facts and Fancies in Modern Science*, lect. 1, p. 15. (A. B. P. S.)

3591. VAGUENESS OF ORDINARY KNOWLEDGE—*Ideas of a Babe—Layman at Shipwreck, Battle, or Fire.*—All our knowledge at first is vague. When we say that a thing is vague, we mean that it has no subdivisions *ab intra*, nor precise limitations *ab extra*; but still all the forms of thought may apply to it. It may have unity, reality, externality, extent, and what-not—*thinghood*, in a word, but thinghood only as a whole. In this vague way, probably, does the room appear to the babe who first begins to be conscious of it as something other than his moving nurse. It has no subdivisions in his mind, unless, perhaps, the window is able to attract his separate notice. In this vague way, certainly, does every entirely new experience appear to the adult. A library, a museum, a machine-shop, are mere confused wholes to the uninstructed, but the machinist, the antiquary, and the bookworm perhaps hardly notice the whole at all, so eager are they to pounce upon the details. Familiarity has in them bred discrimination. . . . A layman present at a shipwreck, a battle, or a fire is helpless. Discrimination has been so little awakened in him by experience that his consciousness

leaves no single point of the complex situation accented and standing out for him to begin to act upon. But the sailor, the fireman, and the general know directly at what corner to take up the business. They "see into the situation"—that is, they analyze it—with their first glance. It is full of delicately differenced ingredients which their education has little by little brought to their consciousness, but of which the novice gains no clear idea.—JAMES *Psychology*, vol. ii, ch. 22, p. 343. (H. H. & Co., 1890.)

3592. VALE OF FIREFLIES—*Air Laden with Phosphorescent Odor.*—Riding on the pampas one dark evening an hour after sunset, and passing from high ground overgrown with giant thistles to a low plain covered with long grass, bordering a stream of water, I found it all ablaze with myriads of fireflies. I noticed that all the insects gave out an exceptionally large, brilliant light, which shone almost steadily. The long grass was thickly studded with them, while they literally swarmed in the air, all moving up the valley with a singularly slow and languid flight. When I galloped down into this river of phosphorescent fire my horse plunged and snorted with alarm. I succeeded at length in quieting him, and then rode slowly through, compelled to keep my mouth and eyes closed, so thickly did the insects rain on to my face. The air was laden with the sickening phosphorous smell they emit; but when I had once got free of the broad fiery zone, stretching away on either hand for miles along the moist valley, I stood still and gazed back for some time on a scene the most wonderful and enchanting I have ever witnessed.—HUDSON *Naturalist in La Plata*, ch. 13, p. 173. (C. & H., 1895.)

3593. VALLEY LIFELESS AND SILENT—*Scenery of the Val del Bove, Mount Etna.*—This plain has been deluged by repeated streams of lava; and altho it appears almost level when viewed from a distance, it is in fact more uneven than the surface of the most tempestuous sea. . . .

An unusual silence prevails; for there are no torrents dashing from the rocks nor any movement of running water in this valley, such as may almost invariably be heard in mountainous regions. Every drop of water that falls from the heavens, or flows from the melting ice and snow, is instantly absorbed by the porous lava; and such is the dearth of springs that the herdsman is compelled to supply his flocks, during the hot season, from stores of snow laid up in hollows of the mountain during winter.

The strips of green herbage and forest land which have here and there escaped the burning lavas serve, by contrast, to heighten the desolation of the scene. When I visited the valley, nine years after the eruption of 1819, I saw hundreds of trees, or rather the white skeletons of trees, on the borders of the black lava, the trunks and branches being all leafless and deprived of their bark by the scorching heat emitted from the melted rock; an image recalling those beautiful lines:

> As when heaven's fire
> Hath scath'd the forest oaks, or mountain pines,
> With singed top their stately growth, tho bare,
> Stands on the blasted heath.

—LYELL *Principles of Geology*, bk. ii, ch. 25, p. 405. (A., 1854.)

3594. VALLEY PARTITIONED BY MEETING DELTAS—The separation of lakes Brienz and Thun, Switzerland, has been cited by Davis as an example of the partitioning of a valley by the union of deltas from opposite sides. Interlaken stands on the beautiful alluvial plain thus formed. Several other similar examples in central Europe have been described by various authors.—RUSSELL *Lakes of North America*, ch. 1, p. 7. (G. & Co., 1895.)

3595. VALLEYS HOLLOWED BY GLACIERS—*Ice, Sand, and Water Combine to Wear Away Rocks.*—In the case of every glacier we have two agents at work—the ice exerting a crushing force on every point of its bed which bears its weight, and either rasping this point into powder or tearing it bodily from the rock to which it belongs; while the water which everywhere circulates upon the bed of the glacier continually washes the detritus away and leaves the rock clean for further abrasion. Confining the action of glaciers to the simple rubbing away of the rocks, and allowing them sufficient time to act, it is not a matter of opinion, but a physical certainty, that they will scoop out valleys.—TYNDALL *Hours of Exercise in the Alps*, ch. 20, p. 238. (A., 1898.)

3596. VALUE OF LEAST PROMISING ELEMENT—*The Layer of Scum and Mud the Most Important Part of Filter.*—Koch maintained that the portion of the filter-bed which really removed micro-organisms effectively was the slimy organic layer upon the surface. This layer is produced by a deposit from the still unpurified water lying immediately above it. The most vital part of the filter-bed is this organic layer, which, after formation, should not be disturbed until it requires removal owing to its impermeability. . . . The only vital part of the [filtration] process . . . is the chemical effect of the layer of scum and mud on the surface of the sand at the top of the filter-bed. The mechanical part of this layer is, of course, the holding back of the particulate matter which has not subsided in the reservoir; the vital action consists in what is termed nitrification of unoxidized substance, which is accomplished in this layer of organic matter.—NEWMAN *Bacteria*, ch. 2, p. 75. (G. P. P., 1899.)

3597. VALUE OF SIMPLICITY—*Plain Food Best for Constant Use—Codfish Used Like Bread—The Bonito of the Mediterranean.*—By boiling out the rich oil of

the salmon, the Norwegian reduces it nearly to the condition of codfish, concerning which I learned a curious fact from two old Dogger Bank fishermen with whom I had a long sailing cruise from the Golden Horn to the Thames. They agreed in stating that codfish is like bread, that they and all their mates lived upon it (and sea-biscuits) day after day for months together, and never tired, while richer fish ultimately became repulsive if eaten daily. This statement was elicited by an immediate experience. We were in the Mediterranean, where bonito were very abundant, and every morning and evening I amused myself by spearing them from the martingale of the schooner, and so successfully that all hands (or rather mouths) were abundantly supplied with this delicious dark-fleshed, full-blooded, and high-flavored fish. I began by making three meals a day on it, but at the end of about a week was glad to return to the ordinary ship's fare of salt junk and chickens.—WILLIAMS *Chemistry of Cookery*, ch. 3, p. 29. (A., 1900.)

3598. VALUE OF THE MINUTE THINGS—*Bacteria Essentially Beneficial—Man's Perversion of Nature Makes Them Noxious.*—We learn, too, another lesson from this latest discovery of the secrets of the living universe. . . . For these minute bacteria of various kinds are present everywhere—in the air, in the water, in the soil under our feet. Their function appears to be to break up by putrefactive processes all dead organized matter, and thus prepare it for being again assimilated by plants, so as to form food for animals and for man; and it seems probable that they prepare the soil itself for plant-growth by absorbing and fixing the nitrogen of the atmosphere. They are, in fact, omnipresent, and under normal conditions they are wholly beneficial. It is we ourselves who, by our crowded cities, our polluted streams, and our unnatural and unwholesome lives, enable them to exert their disease-creating powers.—WALLACE *The Wonderful Century*, ch. 14, p. 146. (D. M. & Co., 1899.)

3599. VALUE OF THE UNKNOWN AND HIDDEN—*Utility of the Earth's Mass—Stability Depends on Gravity—Difference of Weight on the Earth and on Mars.*—A body which would weigh 27 pounds on the earth would, if removed to Mars, weigh only 10 pounds. . . . Whewell remarks that in such a case "we should discover the want of the usual force of gravity by the instability of all about us. Things would not lie where we placed them, but would slide away with the slightest push. We should have a difficulty in standing or walking, something like what we have on shipboard when the deck is inclined; and we should stagger helplessly through an atmosphere thinner than that which oppresses the respiration of the traveler on the tops of the highest mountains." And he very well notes that all this shows the real importance of those dark and unknown central portions of the earth which we are apt to regard as "deposits of useless lumber without effect or purpose. We feel their influence on every step we take and on every breath we draw; and the powers we possess and the comforts we enjoy would be unprofitable to us if they had not been prepared with reference to those as well as to the near and visible portions of the earth's mass."—PROCTOR *Expanse of Heaven*, p. 71. (L. G. & Co., 1897.)

3600. VARIABILITY GENERAL AMONG PLANTS AND ANIMALS—Individual variability is a general character of all common and wide-spread species of animals or plants; and, further, . . . this variability extends, so far as we know, to every part and organ, whether external or internal, as well as to every mental faculty. Yet more important is the fact that each part or organ varies to a considerable extent independently of other parts. Again, we have shown by abundant evidence that the variation that occurs is very large in amount—usually reaching 10 or 20, and sometimes even 25 per cent. of the average size of the varying part; while not 1 or 2 only, but from 5 to 10 per cent. of the specimens examined exhibit nearly as large an amount of variation.—WALLACE *Darwinism*, ch 3, p. 58. (Hum.)

3601. VARIABILITY OF ADJUSTMENT—*Constancy of Force Admits Variety of Adaptation—Contrivance in Constitution of the Universe.*—The superstition which saw in all natural phenomena the action of capricious deities was not more irrational than the superstition which sees in them nothing but the action of invariable law. Men have been right, and not wrong, when they saw in the facts of Nature the variability of adjustment even more clearly and more surely than they saw the constancy of force. They were right when they identified these phenomena with the phenomena of mind. They were right when they regarded their own faculty of contrivance as the nearest and truest analogy by which the constitution of the universe can be conceived and its order understood. They were right when they regarded its arrangements as susceptible of change, and when they looked upon a change of will as the efficient cause of other changes without number and without end. It was well to feel this by the force of instinct; it is better still to be sure of it in the light of reason. It is an immense satisfaction to know that the result of logical analysis does but confirm the testimony of consciousness, and run parallel with the primeval traditions of belief.—ARGYLL *Reign of Law*, ch. 7, p. 231. (Burt.)

3602. VARIABILITY IN THE COMBINATION OF FORCES—*Will Finds Room in the Variation.*—When . . . scientific men speak, as they often do, of all phenomena

being governed by invariable laws, they use language which is ambiguous, and in most cases they use it in a sense which covers an erroneous idea of the facts. There are no phenomena visible to man of which it is true to say that they are governed by any invariable force. That which does govern them is always some variable combinations of invariable forces. But this makes all the difference in reasoning on the relation of will to law—this is the one essential distinction to be admitted and observed. There is no observed order of facts which is not due to a combination of forces; and there is no combination of forces which is invariable—none which are not capable of change in infinite degrees.—ARGYLL *Reign of Law*, ch. 2, p. 59. (Burt.)

3603. VARIATION IN THE ACTION OF EROSIVE FORCES—*Currents, Tides, Waves, Elevation and Depression of Lands.*—We can explain why the intensity of the force of aqueous causes should be developed in succession in different districts. Currents, for example, tides, and the waves of the sea, cannot destroy coasts, shape out or silt up estuaries, break through isthmuses, and annihilate islands, form shoals in one place and remove them from another, without the direction and position of their destroying and transporting power becoming transferred to new localities. Neither can the relative levels of the earth's crust above and beneath the waters vary from time to time, as they are admitted to have varied at former periods, and as it will be demonstrated that they still do, without the continents being, in the course of ages, modified, and even entirely altered, in their external configuration. Such events must clearly be accompanied by a complete change in the volume, velocity, and direction of the streams and land floods to which certain regions give passage. That we should find, therefore, cliffs where the sea once committed ravages, and from which it has now retired; estuaries where high tides once rose, but which are now dried up; valleys hollowed out by water, where no streams now flow, is no more than we should expect; these and similar phenomena are the necessary consequences of physical causes now in operation; and if there be no instability in the laws of Nature, similar fluctuations must recur again and again in time to come.—LYELL *Principles of Geology*, bk. ii, ch. 22, p. 344. (A., 1854.)

3604. VARIATION OF MAGNETIC NEEDLE—*Its Correspondence with Sun-spots—Needle in Cellar at Paris Responds to Aurora Borealis in Sweden and Norway.*—Our planet is alive with a certain stellar life which we cannot yet sufficiently understand. Magnetic currents circulate in it, and incessantly, under their mysterious influence, the magnetic needle seeks the north with its restless and agitated finger. The intensity and direction of these currents vary day by day, year by year, century by century. . . . Here is an important secular variation which has caused many maritime disasters to pilots who are ignorant of it. We may add that every day this curious needle deviates from its magnetic meridian towards the east at eight o'clock in the morning, and towards the west at one o'clock in the afternoon. The extent of this variation varies year by year, and, what is truly surprising, this variation appears to correspond with the number of spots visible on the sun; it is in the years when there are most spots that this fluctuation is most marked. The number of auroræ boreales seems likewise connected with the state of the day-star. Indeed, the magnetic needle enclosed in a cellar of the Paris Observatory follows the aurora borealis which lights its aerial fires in Sweden and Norway. It is restless, agitated—I might say, feverish; more than that, infatuated—and its disturbance only ceases when the distant meteor has disappeared. What books like the book of Nature! And how strange it is that it has so few readers!—FLAMMARION *Popular Astronomy*, bk. i, ch. 6, p. 67. (A.)

3605. VARIATION OF ORGANISMS FROM COMMON TYPE—*Varieties of the Apple.*—All our apples are known to have descended from the common crab of our hedges *(Pyrus Malus)*, and from this at least a thousand distinct varieties have been produced. These differ greatly in the size and form of the fruit, in its color, and in the texture of the skin. They further differ in the time of ripening, in their flavor, and in their keeping properties; but apple-trees also differ in many other ways. The foliage of the different varieties can often be distinguished by peculiarities of form and color, and it varies considerably in the time of its appearance.—WALLACE *Darwinism*, ch. 4, p. 62. (Hum.)

3606. VARIATION OF STARLIGHT IN TRAVERSING EARTH'S ATMOSPHERE—*Scintillation Diminishes with Altitude—Tranquillity of the Stars as Seen from a Balloon.*—The light which reaches us from the stars is subject, in traversing our atmosphere, to slight variations of aspect, according to its original intensity, its vivacity, its tint; in a word, according to its own nature. The higher we rise in the air, the more the scintillation diminishes. At the tops of mountains it appears very feeble. During the nights which I have had the pleasure of passing in a balloon I have been surprised at the calm and majestic tranquillity of the celestial torches, which seemed to correspond with the silence and profound solitude by which I was surrounded.—FLAMMARION *Popular Astronomy*, bk. vi, ch. 6, p. 607. (A.)

3607. VARIATION THE RULE IN NATURE—*All Qualities Affected by It.*—The experience of breeders and cultivators . . .

proves that variation is the rule instead of the exception, and that it occurs, more or less, in almost every direction. This is shown by the fact that different species of plants and animals have required different kinds of modification to adapt them to our use, and we have never failed to meet with variation in that particular direction, so as to enable us to accumulate it and so to produce ultimately a large amount of change in the required direction.—WALLACE *Darwinism*, ch. 4, p. 61. (Hum.)

3608. VARIETIES MUST PRECEDE SELECTION—*Natural Selection Not a Cause—Darwin's Admission.*—To me it seems that Professor Huxley and his followers in this line of argument have entirely overlooked the consideration, that before natural selection among varietal forms could come into operation, there must have been varieties to select from—that for the "fittest" to have survived, they must have come to possess the structure that made them the fittest. It was very early pointed out that natural selection only expresses a general fact, and can in no sense be accounted a *vera causa;* and this, in his later years, Mr. Darwin showed himself quite willing to admit. In what I believe to be his last public utterance on the subject, he spoke of the causes of variation as at present the greatest problem of biological science; and the greater our success in the investigation of it, the more surely—I feel convinced—shall we recognize the evidences of an originating design.—CARPENTER *Nature and Man*, lect. 15, p. 436. (A., 1889.)

3609. VARIETIES OF DOGS—*Not Found in Wild State.*—The numerous races of dogs which we have produced by domesticity are nowhere to be found in a wild state. In Nature we should seek in vain for mastiffs, harriers, spaniels, greyhounds, and other races, between which the differences are sometimes so great that they would be readily admitted as specific between wild animals; "yet all these have sprung originally from a single race, at first approaching very near to a wolf, if, indeed, the wolf be not the true type which at some period or other was domesticated by man." —LYELL *Principles of Geology*, bk. iii, ch. 33, p. 570. (A., 1854.)

3610. VARIETIES SCORNED BY THE OLDER NATURALISTS—*Now Sought and Cherished.*—By the older naturalists, indeed, varieties—especially if numerous, small, and of frequent occurrence—were looked upon as an unmitigated nuisance, because they rendered it almost impossible to give precise definitions of species, then considered the chief end of systematic natural history. Hence it was the custom to describe what was supposed to be the "typical form" of species, and most collectors were satisfied if they possessed this typical form in their cabinets. Now, however, a collection is valued in proportion as it contains illustrative specimens of all the varieties that occur in each species, and in some cases these have been carefully described, so that we possess a considerable mass of information on the subject.—WALLACE *Darwinism*, ch. 3, p. 28. (Hum.)

3611. VARIETY IN THE UNIVERSE—*Aggregations of Stars—Different Magnitudes Intermingled—The Milky Way.*—Here, then, is fresh evidence of the wonderful constitution of the Milky Way. We see that this complicated aggregation of star-streams—for such is the true description of the galaxy—consists in the main of a multitude of relatively minute stars, amidst which many stars, so large as to be visible to the naked eye, are scattered, while also stars of intermediate orders are gathered with great richness in the same region of space. It follows that when Sir W. Herschel was endeavoring by means of his powerful telescopes to resolve the cloudy light of the Milky Way into separate stars he was not really penetrating, as he supposed, to the remotest limits of our stellar system, and bringing into view stars which were at a relatively enormous distance, but in many cases at least was simply scrutinizing more and more closely certain definite aggregations of stars, of many orders of real magnitude, all intermixed together in the same region of space. . . . Our stellar universe, in fact, no longer presents the uniform aspect which it had assumed as interpreted by Sir W. Herschel, but shows varieties of structure and of aggregation corresponding with, but far surpassing in degree, those which we recognize in the solar system.—PROCTOR *Expanse of Heaven*, p. 273. (L. G. & Co., 1897.)

3612. ——— ——— *Creation Not Held to the Single Model of Our Sun and Solar System—Pairs and Clusters of Suns of Varying Color and Brightness.*—The most beautiful contrasts of coloring are not presented by the systems in rapid motion, but by the systems in slow motion, and even in those which have remained motionless since their discovery. This curious fact does not prevent the planets which gravitate round these latter suns from being subject to the most singular alternations of illumination, of seasons, and of years. Our white and solitary sun, our solar system formed with a single focus round which revolve obedient worlds, following regular orbits, does not constitute the type and the model of universal creation. The multiple suns which we study here sometimes unite their light, sometimes oppose each other, sometimes alternate successively in the same sky; suns of dissimilar volumes and masses, acting often in contrary directions and distorting the singular orbits of the unknown worlds which gravitate in their power. No spectacle is more magnificent than the telescopic contemplation of these strange suns. When in the

silent night, during the sleep of terrestrial Nature, in those nocturnal hours when humanity around us is asleep in anticipated death, our gaze and our thoughts are elevated by the aid of the marvelous telescope towards these celestial lights which are lit up on high from other worlds, and radiate around them heat, activity, and life, the contrast is so great that we think we dream. Here night, above light; here lethargy, above motion; here shadows, above splendor; here heavy and dark matter, above the devouring flame and the sidereal life.—FLAMMARION *Popular Astronomy*, bk. vi, ch. 9, p. 638. (A.)

3613. ——— ——— *Cycles of Revolution of Stellar Systems.*—Notwithstanding the enormous distances which separate these stars [of one system] from each other, yet vaster distances, or rather distances of a higher order of vastness, separate that system of stars from the surrounding parts of the galaxy. It presents to us, also, the wonderful thought that cycles of revolution must exist within that system, compared with which the longest periods of motion recognized within our solar system must be regarded as absolutely insignificant. We are shown in such star-systems an order of created things unlike any that before we had known. One other form of evidence has been given to show the infinite variety which pervades every part of the universe. —PROCTOR *Expanse of Heaven*, p. 296. (L. G. & Co., 1897.)

3614. ——— ——— *Stars and Nebulæ Intermingled in Same Great Group.*—There is no maintaining nebulæ to be simply remote worlds of stars, in the face of an agglomeration like the Nubecula Major, containing in its (certainly capacious) bosom both stars and nebulæ. Add the evidence of the spectroscope to the effect that a large proportion of these perplexing objects are gaseous, with the intimate relation obviously subsisting between the mode of their scattering and the lie of the Milky Way, and it becomes impossible to resist the conclusion that both nebular and stellar systems are parts of a single scheme.—CLERKE *History of Astronomy*, pt. ii, ch. 12, p. 505. (Bl., 1893.)

3615. ——— ——— *The Heavens Transfigured.*—Science is only beginning to penetrate into the starry immensity. Even yesterday we were ignorant of the number of the real double stars now observed, the diversity of their motions, and their proportion in the organization of the heavens. We may estimate that about one-fifth of the suns of which the universe is composed are not single, like that which illuminates us, but associated in binary, ternary, or multiple systems. Thus the double stars are veritable suns, gigantic and powerful, governing, in the regions illuminated by their splendor, systems different from that of which we form part. The sky is no longer a gloomy desert; its ancient solitudes have given place to regions peopled like those in which the earth gravitates; the darkness, the silence and death which reigned in these depths have given place to light, to motion, and to life; thousands and millions of suns pour out in great waves into space the energy, the heat, and the different undulations which emanate from their foci; the universe is transfigured to our thoughts; suns succeed to suns, worlds to worlds, universes to universes; tremendous proper motions carry all these systems through the endless regions of immensity; and everywhere, out to and beyond the farthest limits where the fatigued imagination may rest its wings, everywhere is developed in infinite variety the divine creation in which our microscopical planet is but an insignificant province.—FLAMMARION *Popular Astronomy*, bk. vi, ch. 8, p. 640. (A.)

3616. ——— ——— *Varying Length of Years.*—What inexhaustible variety distinguishes the planets from each other! On the moon, for example, there are but twelve days and twelve nights in a year, and yet their year is of the same length as ours. Here we count 365 days in a year. On Jupiter the year is nearly twelve times longer than ours, and the day less than half the terrestrial day; hence it follows that there are no less than 10,455 days in the year of that world! On Saturn the disproportion is still more extraordinary; for its year, thirty times longer than ours, contains 25,217 days. And what shall we say of Neptune, whose year lasts for a century and a half—165 of our rapid years! If biology is there regulated in the same proportions, a young girl of seventeen years on Neptune would really have lived 2,800 of our years; she would have lived nearly a thousand years before Christ was born in Judea; she would have been contemporary with Romulus, Julius Cæsar, Constantine, Clovis, Charlemagne, François I., Louis XIV., Robespierre—and she would still be only seventeen! Lethargic fiancée, she will marry in three or four hundred years a young man of her dreams aged himself more than three thousand terrestrial years.—FLAMMARION *Popular Astronomy*, bk. i, ch. 2, p. 13. (A.)

3617. VARIETY IN UNITY—*Similarity in Structure of Diverse Parts.*—The similar framework of bones in the hand of a man, wing of a bat, fin of the porpoise, and leg of the horse—the same number of vertebræ forming the neck of the giraffe and of the elephant—and innumerable other such facts, at once explain themselves on the theory of descent with slow and slight successive modifications. The similarity of pattern in the wing and in the leg of a bat, tho used for such different purpose, in the jaws and legs of a crab, in the petals, stamens, and pistils of a flower, is likewise, to a large extent, intelligible on the view of the gradual modification of parts or organs.

which were aboriginally alike in an early progenitor in each of these classes.—DARWIN *Origin of Species*, ch. 15, p. 494. (Burt.)

3618. VARIETY OF COLOR AMONG THE STARS—*Double Stars of Complementary Colors.*—A careful examination of the bright double stars . . . teaches that, besides white, all the colors of the solar spectrum are to be found in the double stars, but that the principal star, whenever it is not white, approximates in general to the red extreme (that of the least refrangible rays), but the companion to the violet extreme (the limit of the most refrangible rays). The reddish stars are twice as frequent as the blue and bluish; the white are about two and a half times as numerous as the red and reddish. It is moreover remarkable that a great difference of color is usually associated with a corresponding difference in brightness. In two cases—in ζ Bootis and γ Leonis—which, from their great brightness, can easily be measured by powerful telescopes, even in the daytime, the former consists of two white stars of the third and fourth magnitudes, and the latter of a principal star of the second, and of a companion of the 3.5th magnitude. This is usually called the brightest double star of the northern hemisphere, whereas α Centauri and α Crucis, in the southern hemisphere, surpass all the other double stars in brilliancy. . . . "This superb double star (α Centauri) is beyond all comparison the most striking object of the kind in the heavens, and consists of two individuals, both of a high ruddy or orange color, tho that of the smaller is of a somewhat more somber and brownish cast." (Sir John Herschel, "Observations at the Cape of Good Hope," p. 300.)—HUMBOLDT *Cosmos*, vol. iii, p. 209. (H., 1897.)

3619. VARIETY OF COLOR IN DEEP-SEA ECHINODERMS—*Compared to Autumn Leaves.*—It is impossible to account for [the] extraordinary variety of color in the deep-sea echinoderms. It is hardly probable that it can be protective or warning in function, and it is difficult to suppose that it is due to any peculiar excretory process. Whether it is due in any way to the influence of the environment, or, like the color of autumn leaves, to the chemical degeneration of colors that in the shallow-water ancestry were functional, are problems that must be left for the future to decide.—HICKSON *Fauna of the Deep Sea*, ch. 4, p. 64. (A., 1894.)

3620. VARIETY OF MOVEMENT OF COMETS—*Celestial Visitors Captives of Sun's Attraction.*—Four principal characteristics distinguish comets from planets: (1) Their nebulous aspect and their tails, often considerable; (2) the length of the elliptical orbits which they describe; (3) the inclination of these orbits, which, instead of lying in the plane of the ecliptic, or at least in the zodiac, like those of the planets in general, are inclined at all degrees up to a right angle, and sometimes carry the comets to the polar constellations; (4) the directions of their motions, which, instead of being performed in the same direction as those of planets, are, some direct, others retrograde, and appear to be strangers to any unity of plan. From these circumstances the certain conclusion follows that comets have not the same origin as the planets, that they did not originally belong to the solar system, that they travel through immensity, that they may be transported from one sun to another (from star to star), and that those which revolve round our sun have been caught in their passage by his attraction, having had their course curved and closed by the influence of the planets of our system.—FLAMMARION *Popular Astronomy*, bk. v, ch. 2, p. 489. (A.)

3621. VARIETY OF NATURE—*Aurora Ranges from Low Elevation Up to Hundreds of Miles.*—From all this evidence we are entitled to conclude that the altitude of polar auroras varies within very wide limits, and that, in spite of the opinion of certain authors, it is certainly possible to observe auroral manifestations quite near the surface of the earth. . . .

But let us distinguish. In mean latitudes, in France and Central Europe, all measurements of the height of the aurora have always given very high numbers [by some observers in some instances estimated at more than 500 miles]. . . . It is only in latitudes above the 55th or 60th parallel that auroras are undoubtedly found at a much lower level, and sometimes even quite near the surface of the earth. It seems, then, lawful to assume that the mean height at which the aurora is produced diminishes as we approach the poles. Perhaps exceeding 100 kilometers (60 miles) in low latitudes, it descends to some tens of miles in the arctic regions, and may even be quite near the ground.—ANGOT *Aurora Borealis*, ch. 4, p. 68. (A., 1897.)

3622. ——— ——— *Close Observation Finds Endless Differences—Shepherd Knows Individual Sheep.*—If we look about us in a forest consisting of only a single species of tree, for example, of beech, we shall certainly not find in the whole forest two trees of this kind which are absolutely identical or perfectly equal in the form of their branches, the number of their branches, and leaves, blossoms, and fruits. Special differences occur everywhere, just as in the case of men. There are no two men who are absolutely identical, perfectly equal in size, in the formation of their faces, the number of their hairs, their temperament, character, etc. The very same is true of individuals of all the different species of animals and plants. It is true that in most organisms the differences are very trifling to the eye of the uninitiated. Everything here essen-

tially depends on the exercise of the faculty of discovering these often very minute differences of form. The shepherd, for example, knows every individual of his flock, solely by accurately observing their peculiarities, while the uninitiated are incapable of distinguishing at all the different individuals of one and the same flock.—HAECKEL *History of Creation*, vol. i, ch. 7, p. 158. (K. P. & Co., 1899.)

3623. —— —— *Results Wrought from a Few Elements—As Language from the Alphabet.*—The number of substances deemed elementary has varied with the advance of science; but as compared with the variety of their products, that number may be considered as infinitesimally small; whilst the progress of analysis, with glimpses of laws as yet unknown, renders it almost certain that this number will be found to be smaller still. Yet out of that small number of elementary substances, having fixed rules, too, limiting their combination, all the infinite varieties of organic and inorganic matter are built up by means of nice adjustment. As all the faculties of a powerful mind can utter their voice in language whose elements are reducible to twenty-four letters, so all the forms of Nature, with all the ideas they express, are worked out from a few simple elements having a few simple properties.—ARGYLL *Reign of Law*, ch. 2, p. 57. (Burt.)

3624. VARIETY OF TONES AMONG ANIMALS—*Darwin's Six Modulations in the Bark of the Dog—From These May Spring a Full Vocabulary.*—The howl of the dog, the neigh of the horse, the bleat of the lamb, the stamp of the goat, and other signs are all readily understood by other animals. One monkey utters at least six different sounds to express its feelings; and Mr. Darwin has detected four or five modulations in the bark of the dog: "the bark of eagerness, as in the chase; that of anger as well as growling; the yelp or howl of despair when shut up; the baying at night; the bark of joy when starting on a walk with his master; and the very distinct one of demand or supplication, as when wishing for a door or window to be opened." Now these signs are as much language as spoken words. You have only to evolve this to get all the language the dictionary-maker requires.—DRUMMOND *Ascent of Man*, p. 158. (J. P., 1900.)

3625. VASTNESS, SENSE OF—*Plainsman's First Experience of a Hill.*—I remember my first experience of a hill, after having been shut within "these narrow limits." It was one of the range of Sierras near Cape Corrientes, and not above eight hundred feet high; yet, when I had gained the summit, I was amazed at the vastness of the earth, as it appeared to me from that modest elevation. Persons born and bred on the pampas, when they first visit a mountainous district, frequently experience a sensation as of "a ball in the throat," which seems to prevent free respiration.—HUDSON *Naturalist in La Plata*, ch. 1, p. 5. (C. & H., 1895.)

3626. VAULT OF HEAVEN—*Ancients Regarded the Heavens as Made of Glass—The "Crystal Sphere."*—Altho, according to Stobæus and the collector of the "Views of the Philosophers," the designation "crystal vault of heaven" dates as far back as the early period of Anaximenes, the first clearly defined signification of the idea on which the term is based occurs in Empedocles. This philosopher regarded the heaven of the fixed stars as a solid mass, formed from the ether which had been rendered crystalline and rigid by the action of fire. According to his theory, the moon is a body conglomerated (like hail) by the action of fire, and receives its light from the sun. The original idea of transparency, congelation, and solidity would not, according to the physics of the ancients, and their ideas of the solidification of fluids, have referred directly to cold and ice; but the affinity between κρύσταλλος, κρύος, and κρυσταίνω, as well as this comparison with the most transparent of all bodies, gave rise to the more definite assertion that the vault of heaven consisted of ice or of glass. Thus we read in Lactantius: "Cœlum aërem glaciatum esse" and "vitreum cœlum." Empedocles undoubtedly did not refer to the glass of the Phenicians, but to air, which was supposed to be condensed into a transparent solid body by the action of the fiery ether. In this comparison with ice (κρύσταλλος), the idea of transparency predominated, no reference being here made to the origin of ice through cold, but simply to its conditions of transparent condensation. While poets used the term crystal, prose writers . . . limited themselves to the expression crystalline or crystal-like, κρυσταλλοειδής. In like manner, πάγος (from πήγνυσθαι, to become solid) signifies a piece of ice—its condensation being the sole point referred to.—HUMBOLDT *Cosmos*, vol. iii, p. 123. (H., 1897.)

3627. VEGETATION AND CRYSTALLIZATION—*Lake of the Solfatara—Contrast of the Animate and the Inanimate.*—In the Campagna, between Rome and Tivoli, is the Lake of the Solfatara, called also Lago di Zolfo *(lacus albula)*, into which flows continually a stream of tepid water from a smaller lake, situated a few yards above it. The water is a saturated solution of carbonic-acid gas, which escapes from it in such quantities in some parts of its surface that it has the appearance of being actually in ebullition. "I have found by experiment," says Sir Humphry Davy, "that the water taken from the most tranquil part of the lake, even after being agitated and exposed to the air, contained in solution more than its own volume of carbonic-acid gas, with a very small quantity of sulfureted hydrogen. Its

high temperature, which is pretty constant at 80° F., and the quantity of carbonic acid that it contains, render it peculiarly fitted to afford nourishment to vegetable life. The banks of travertin are everywhere covered with reeds, lichen, confervæ, and various kinds of aquatic vegetables; and at the same time that the process of vegetable life is going on the crystallizations of the calcareous matter, which is everywhere deposited in consequence of the escape of carbonic acid, likewise proceed. There is, I believe, no place in the world where there is a more striking example of the opposition or contrast of the laws of animate and inanimate Nature, of the forces of inorganic chemical affinity, and those of the powers of life."

The same observer informs us that he fixed a stick in a mass of travertin covered by the water in the month of May, and in April following he had some difficulty in breaking, with a sharp-pointed hammer, the mass which adhered to the stick, and which was several inches in thickness. The upper part was a mixture of light tufa and the leaves of confervæ; below this was a darker and more solid travertin, containing black and decomposed masses of confervæ; in the inferior part the travertin was more solid, and of a gray color, but with cavities probably produced by the decomposition of vegetable matter.—LYELL *Principles of Geology*, bk. ii, ch. 16, p. 243. (A., 1854.)

3628. VEGETATION, GIGANTIC, OF TROPICS—*A Forest of Arum.*—One of the islands was low and sandy, and half of it was covered with gigantic arum-trees, the often-mentioned *Caladium arborescens*, which presented a strange sight. Most people are acquainted with the little British species *Arum maculatum*, which grows in hedge-bottoms, and many, doubtless, have admired the larger kinds grown in hot-houses; they can therefore form some idea of a forest of arums. On this islet the woody stems of the plants near the bottom were eight to ten inches in diameter, and the trees were twelve to fifteen feet high, all growing together in such a manner that there was just room for a man to walk freely between them. There was a canoe inshore, with a man and a woman; the man, who was hooting with all his might, told us in passing that his son was lost in the "aningal" (arum-grove). He had strayed while walking ashore, and the father had been an hour waiting for him in vain. —BATES *Naturalist on the River Amazon*, ch. 5, p. 664. (Hum., 1880.)

3629. VEGETATION, MICROSCOPIC—*The "Red Snow" of the Alps.*—Sometimes, in the midst of the wide expanse, one comes upon a patch of the so-called red snow of the Alps. At a distance one would say that such a spot marked some terrible scene of blood, but, as you come nearer, the hues are so tender and delicate, as they fade from deep red to rose, and so die into the pure colorless snow around, that the first impression is completely dispelled. This red snow is an organic growth, a plant springing up in such abundance that it colors extensive surfaces, just as the microscopic plants dye our pools with green in the spring. It is an alga *(Protocoites nivalis)*, well known in the arctics, where it forms wide fields in the summer.—AGASSIZ *Geological Sketches*, ser. i, ch. 8, p. 227. (H. M. & Co., 1896.)

3630. VELOCITY OF LIGHT—*Exactness of Newcomb's Observations—Rays Sent Across a Measured Space.*—All earlier efforts of the kind were thrown into the shade by Professor Newcomb's arduous operations at Washington in 1880-1882. The scale upon which they were conducted was in itself impressive. Foucault's entire apparatus in 1862 had been enclosed in a single room; Newcomb's revolving and fixed mirrors, between which the rays of light were to run their timed course, were set up on opposite shores of the Potomac, at a distance of nearly four kilometers [about 2½ miles]. This advantage was turned to the utmost account by ingenuity and skill in contrivance and execution; and the deduced velocity of 299,860 kilometers (=186,328 miles) a second had an estimated error (30 kilometers [18.63 miles]) only one-tenth that ascribed by Cornu to his own result in 1874. —CLERKE *History of Astronomy*, pt. ii, ch. 6, p. 297. (Bl., 1893.)

3631. ———— ———— *Happy Conjecture of Bacon.*—The second book of Lord Bacon's "Novum Organum" gives us the earliest views on the velocity of light and the probability of its requiring a certain time for its transmission. He speaks of the time required by a ray of light to traverse the enormous distances of the universe, and proposes the question whether those stars yet exist which we now see shining. We are astonished to meet with this happy conjecture in a work whose intellectual author was far behind his contemporaries in mathematical, astronomical, and physical knowledge. The velocity of reflected solar light was first measured by Römer (November, 1675) by comparing the periods of occultation of Jupiter's satellites; while the velocity of the direct light of the fixed stars was ascertained (in the autumn of 1727) by means of Bradley's great discovery of aberration, which afforded objective evidence of the translatory movement of the earth, and of the truth of the Copernican system.— HUMBOLDT *Cosmos*, vol. iii, p. 80. (H., 1897.)

3632. VELOCITY OF OCEAN CURRENTS — *Narrowing of Channel Increases Speed of Crowded Waters.*—The ordinary velocity of the principal currents of the ocean is from one to three miles per hour; but when the boundary lands converge, large bodies of water are driven gradually into a narrow space, and then wanting lateral room

are compelled to raise their level. Whenever this occurs their velocity is much increased. The current which runs through the Race of Alderney, between the island of that name and the mainland, has a velocity of about eight English miles an hour. Captain Hewett found that in the Pentland Firth the stream, in ordinary spring tides, runs ten miles and a half an hour, and about thirteen miles during violent storms. The greatest velocity of the tidal current through the "Shoots" or New Passage, in the Bristol Channel, is fourteen English miles an hour; and Captain King observed, in his survey of the Straits of Magellan, that the tide ran at the same rate through the "First Narrows," and about eight geographical miles an hour in other parts of those straits.—LYELL *Principles of Geology*, bk. ii, ch. 19, p. 293. (A., 1854.)

3633. VELOCITY, UNIMAGINABLE, OF ELECTRICITY—*Emblem of Speed of Thought—Moving Bodies Seen Motionless.*—A flash of lightning cleaves a cloud, appearing and disappearing in less than a hundred-thousandth of a second, and the velocity of electricity is such as would carry it in a single second over a distance almost equal to that which separates the earth and moon. It is well known that a luminous impression once made upon the retina endures for about one-sixth of a second, and that this is the reason why we see a continuous band of light when a glowing coal is caused to pass rapidly through the air. A body illuminated by an instantaneous flash continues to be seen for the sixth of a second after the flash has become extinct; and if the body thus illuminated be in motion, it appears at rest at the place where the flash falls upon it. When a color-top with differently colored sectors is caused to spin rapidly the colors blend together. Such a top, rotating in a dark room and illuminated by an electric spark, appears motionless, each distinct color being clearly seen. Professor Dove has found that a flash of lightning produces the same effect. During a thunder-storm he put a color-top in exceedingly rapid motion, and found that every flash revealed the top as a motionless object, with its colors distinct.—TYNDALL *Fragments of Science*, vol. i, ch. 21, p. 440. (A., 1900.)

3634. VENOM ADAPTED TO VICTIM—*One Plan Must Comprehend Destroyer and Destroyed.*—The poison of a deadly snake—let us for a moment consider what this is. It is a secretion of definite chemical properties which have reference, not only—not even mainly—to the organism of the animal in which it is developed, but specially to the organism of another animal which it is intended to destroy. Some naturalists have a vague sort of notion that, as regards merely mechanical weapons, or organs of attack, they may be developed by use—that legs may become longer by fast running, teeth sharper and longer by much biting. Be it so: this law of growth, if it exist, is but itself an instrument whereby purpose is fulfilled. But how will this law of growth adjust a poison in one animal with such subtle knowledge of the organization of another that the deadly virus shall in a few minutes curdle the blood, benumb the nerves, and rush in upon the citadel of life? There is but one explanation—a Mind, having minute and perfect knowledge of the structure of both, has designed the one to be capable of inflicting death upon the other. This mental purpose and resolve is the one thing which our intelligence perceives with direct and intuitive recognition. The method of creation, by means of which this purpose has been carried into effect, is utterly unknown.—ARGYLL *Reign of Law*, ch. 1, p. 21. (Burt.)

3635. VENTILATION IS LIFE—*Deadly Products of Combustion—Breathing Is Combustion without Flame.*—We often take great precautions to prevent its [carbon dioxid or carbonic acid] escape. Scared by the ghosts of rheumatism and neuralgia, some people in winter close the doors of their apartments and stop up every crevice by which fresh air can enter or foul air escape.

By means of a sandbag at the window, another at the door, and a piece of list carefully tacked along its edge, the whole arrangement being supplemented by a screen, the products of combustion and exhalation are kept circulating in the room and breathed over and over again by those within, at the cost of morning headache, languor, and depression, with a long train of other evils following in the wake. From the fire, from the lights, and from the lungs of the inmates, the poisonous gas is evolved, and must be removed by efficient ventilation. We are here struck by the remarkable analogy between the process of combustion and the function of respiration.

The latter is, in fact, a species of combustion without flame. The carbon of the impure venous blood unites with the oxygen of the air to form carbonic acid gas, while the hydrogen unites with another portion of oxygen to form water. Both products are expelled at each exhalation, and the chemical action going on within the body raises its temperature to nearly 100°.—LOWE *Nature-Studies*, p. 4. (Hum., 1888.)

3636. VENTRILOQUISM IN NATURAL MAGIC—*Judgment of Distance Relative.*—A change of wind, an unusual stillness in the air, is quite sufficient to produce the sense that sounding objects are nearer than they actually are. The art of the ventriloquist manifestly aims at producing this kind of illusion. By imitating the dull effect of a distant voice, he is able to excite in the minds of his audience a powerful conviction that the sounds proceed from a distant point. There is little doubt that ventriloquism has played a conspicuous part in the arts of divination and magic.—SULLY *Illusions*, ch. 5, p. 82. (A., 1897.)

3637. VENUS'S FLY-TRAP—*Remarkable Mechanism for Securing Insect Food—Plant Almost without Roots—Leaves Spring upon Prey at a Touch.*—This plant [*Dionæa muscipula*], commonly called Venus's fly-trap, from the rapidity and force of its movements, is one of the most wonderful in the world. It is a member of the small family of the *Droseraceæ*, and is found only in the eastern part of North Carolina, growing in damp situations. The roots are small; those of a moderately fine plant which I examined consisted of two branches about one inch in length, springing from a bulbous enlargement. They probably serve, as in the case of *Drosera*, solely for the absorption of water; for a gardener, who has been very successful in the cultivation of this plant, grows it, like an epiphytic orchid, in well-drained damp moss without any soil. . . . The two lobes stand at rather less than a right angle to each other. Three minute pointed processes or filaments, placed triangularly, project from the upper surfaces of both; but I have seen two leaves with four filaments on each side, and another with only two. These filaments are remarkable from their extreme sensitiveness to a touch, as shown not by their own movement, but by that of the lobes. The margins of the leaf are prolonged into sharp, rigid projections which I will call spikes, into each of which a bundle of spiral vessels enters. The spikes stand in such a position that, when the lobes close, they interlock like the teeth of a rat-trap.—DARWIN *Insectivorous Plants*, ch. 13, p. 232. (A., 1900.)

3638. VERACITY OF ANCIENT TRAVELER VINDICATED—*The Sea of Seaweed.*—His ships, he [Himilco, a Carthaginian explorer of the sixth century B. C.] says, or at least Avienus says for him, were "surrounded by seaweed." Where was he when this took place? All that we can say in answer to this question is that he sailed through the Pillars of Hercules into the Atlantic Ocean, and we know that few days' sail in this direction would have brought him to the "Mare di Sargasso," a sea which has actually taken its name from the quantity of seaweed *(sargasso)* growing in it. Sir G. C. Lewis says, "The notion of remote seas being impassable by ships, either from their shoals, or from the obstacles to navigation produced by the semifluid and muddy properties of the water, frequently recurs among the ancients"; and it is true, no doubt, that statements of this kind are made by many ancient writers, as, for instance, by Herodotus, Plato, Scylax, and even Aristotle; but not one of these writers alludes to "seaweed" as an impediment to navigation, and it can hardly be accidental that the only voyager by whom this is referred to was one who sailed on a course which, if persevered in for a few days, would have brought him to that which is even now known as the Sea of Seaweed.—AVEBURY *Prehistoric Times*, ch. 3, p. 59. (A., 1900.)

3639. —— —— *Unknown Substance Found Covering the Sea—Plates of Ice Like Jellyfish.*—Round the island of Thule Pytheas [a Greek explorer, third century B. C., treated by Polybius, Strabo, and later writers as a mendacious imposter] saw a substance which was neither earth, air, nor water, but a substance resembling medusæ or jellyfishes (πνεύμονι θαλασσίῳ ἐοικὸς), which could neither be passed on foot nor in ships. This passage, which has completely puzzled southern commentators, is justly regarded by Professor Nilsson as a striking evidence of Pytheas's veracity. For when the Northern Ocean freezes, this does not happen as in our ponds or lakes, but small, separate plates of ice are formed, and as soon as this process commences the fishermen hurry to the shore, lest they should be caught in the ice, which for some time is too thick to permit the passage of a boat, yet too weak to support the weight of a man. A very similar description is given by Captain Lyon. "We came," he says, "amongst young ice, in that state called sludge, which resembles in appearance and consistency a far better thing—lemon ice. From this we came to small round plates, of about a foot in diameter, which have the appearance of the scales of gigantic fishes." Richardson also particularly mentions the "circular plates of ice, six or eight inches in diameter." These disks of ice tossed about by the waves suggested to Professor Nilsson himself, when he first saw them, the idea of a crowd of medusæ, and if we imagine a southerner who had never before witnessed such a phenomenon, and who on his return home wished to describe it to his fellow countrymen, it would have been difficult to find an apter or more ingenious simile. It is, moreover, one which would hardly have occurred to any one who had not witnessed the actual phenomenon.—AVEBURY *Prehistoric Times*, ch. 3, p. 62. (A., 1900.)

3640. VERIFICATION OF POPULAR BELIEF—*Naturalist's Observation—Vampire and Horse.*—The vampire-bat is often the cause of much trouble, by biting the horses on their withers. The injury is generally not so much owing to the loss of blood as to the inflammation which the pressure of the saddle afterwards produces. The whole circumstance has lately been doubted in England; I was therefore fortunate in being present when one . . . was actually caught on a horse's back. We were bivouacking late one evening near Coquimbo, in Chile, when my servant, noticing that one of the horses was very restive, went to see what was the matter, and fancying he could distinguish something, suddenly put his hand on the beast's withers and secured the vampire. In the morning the spot where the bite had been inflicted was easily distin-

guished from being slightly swollen and bloody.—DARWIN *Naturalist's Voyage around the World,* ch. 2, p. 22. (A., 1898.)

3641. VERSATILITY OF SCIENTIST —*Mastery of Three Great Departments—The Philosophic Mind Everywhere at Home.* —Wherever mineralogy or geology is taught, the unsurpassed text-books on these subjects by Dana hold easy supremacy. . . . Of his mineralogy Powell says: "Thus he was the first to give us a system of mineralogy; but his work in this field did not end at that stage. He still pursued his investigations, collecting from many fields, and drawing from the collections of many others in many lands, until at last he developed a new system of mineralogy, placing the science on an enduring basis. This accomplishment alone was also worthy of a great man, and by it a new science was organized on a mathematical, chemical, and physical basis."

The broader field of geology became his after his return from the exploring expedition, and he published his "Manual of Geology" in 1862. . . . Concerning his valuable work on geology Powell said: "So Dana's 'Geology' is not only a text-book of geology, but it is the handbook for all national, state, and local geologists and all students in the field. It is the universal book of reference in that department of science. Other text-books have been developed, but no other handbook for America. It is a vast repository of facts, but all arranged in such a manner as to constitute a geologic philosophy. It is on every worker's table, and is carried in the kit of every field observer. It has thus become the standard to which all scientific research is referred, and on which geologic reports are modeled."

Besides the foregoing, Dana was the author of "Coral Reefs and Islands," which he enlarged and published later as "Corals and Coral Islands"; of "The Geological Story Briefly Told"; "The Characteristics of Volcanoes," and "The Four Rocks of the New Haven Region."

In conclusion Powell says of him: "Dana as a zoologist was great, Dana as a mineralogist was greater, but Dana as a geologist was greatest, and Dana in all three was a philosopher; hence Dana's great work is enduring.—MARCUS BENJAMIN *Early Presidents of the American Association* in *Proceedings of Amer. Assoc. for the Advancement of Science, 1899,* p. 16.

3642. VICES OF SAVAGERY NOT PRIMEVAL—*Cannibalism and Infanticide.*—There is an assumption that the further we go back in time there was not only less and less extensive knowledge of the useful arts —not only simpler and simpler systems of life and polity—but also that there were deeper and deeper depths of the special characteristics of the modern savage. We have, however, only to consider what some of these characteristics are to be convinced that, altho they may have arisen in early times, they cannot possibly have existed in the times which were the earliest of all. . . . If, for example, there ever was a time when there existed on one spot of earth, or even on more spots than one, a single pair of human beings, it is impossible that they should have murdered their offspring or that they should have killed and eaten each other. Accordingly it is admitted that cannibalism and infanticide, two of the commonest practises of savage and of barbarous life, cannot have been primeval. But this is a conclusion of immense significance. It hints to us, if it does no more, that what is true of one savage practise may possibly be true of others. It breaks down the presumption that whatever is most savage is therefore probably the most ancient.—ARGYLL *Unity of Nature,* ch. 10, p. 228. (Burt.)

3643. VICTIM OF BOA OR PYTHON DESTITUTE OF FEAR—We have often observed boas and pythons do this [kill their victims by crushing] in captivity, and can affirm that the rabbits and ducks introduced into their cages are entirely destitute of fear or apprehension, and suffer nothing until they are seized, and then their sufferings are extremely brief. Such a serpent, if disposed to feed—to attain which disposition it often needs a fast of several weeks—will move slowly about till it brings its mouth opposite to the muzzle of the rabbit. Then in an instant its mouth is opened and the rabbit's head is seized, while simultaneously the voluminous folds of the powerful body are twined round it, and it is crushed immediately to death. The serpent does not at once uncoil its folds, but continues for a time tightly to embrace its victim, so that reanimation becomes impossible.—MIVART *Types of Animal Life,* ch. 5, p. 141. (L. B. & Co., 1893.)

3644. VICTIM UNWARNED—*Infection Unsuspected—Incubation Period of Typhoid.*—Until intoxication [*i. e.,* toxin poisoning] occurs there may be few or no symptoms, but directly enough bacteria are present to produce in the body certain poisons in sufficient amount to result in more or less marked tissue change, then the symptoms of that tissue change appear. This period of latency between infection and the appearance of the disease is known as the incubation period. Take typhoid, for example. A man drinks a typhoid-polluted water. For about fourteen days the bacilli are making headway in his body without his being aware of it. But at the end of that incubation period the signs of the disease assert themselves.—NEWMAN *Bacteria,* ch. 8, p. 271. (G. P. P., 1899.)

3645. VICTORY OF THE MAMMALS IN ANCIENT STRUGGLE—*Nature Ever Since Perfecting This Highest Type.*—The development of complete mammality was no sudden thing. The results of the struggle

are registered in the Eocene rocks. The ancient world had found its Waterloo. Gone were the dragons who so long had lorded it over both hemispheres—brontosaurs, iguanodons, plesiosaurs, lælaps, pterodactyls—all gone; their uncouth brood quite vanished from the earth, and nothing left alive as a reminder, save a few degenerate, collateral kin, such as snakes and crocodiles, objects of dread and loathing to higher creatures. Never in the history of our planet has there been a more sweeping victory than that of the mammals, nor has Nature had any further occasion for victories of that sort. The mammal remains the highest type of animal existence, and subsequent progress has been shown in the perfecting of that type where most perfectible.—FISKE *Through Nature to God*, pt. ii, ch. 11, p. 125. (H. M. & Co., 1900.)

3646. VIEW, ANCIENT, OF FIXED STARS—*Stars Supposed To Be Riveted to the Vault of Heaven—The "Crystal Sphere."*—The inappropriate expression of fixed stars (*astra fixa* of Manilius) reminds us . . . of the connection, or, rather, confusion of the ideas of insertion, and of absolute immobility or fixity. When Aristotle calls the non-wandering celestial bodies (ἀπλανῆ ἄστρα) riveted (ἐνδεδεμένα), when Ptolemy designates them as ingrafted (προσπεφυκότες), these terms refer specially to the idea entertained by Anaximenes of the crystalline sphere of heaven. The apparent motion of all the fixed stars from east to west, while their relative distances remain unchanged, had given rise to this hypothesis. "The fixed stars (ἀπλανῆ ἄστρα) belong to the higher and more distant regions, in which they are riveted, like nails, to the crystalline heavens; the planets (ἄστρα πλανώμενα or πλανητά), which move in an opposite direction, belong to a lower and nearer region." [Stobæus, "Eclog. Phys.," p. 582.]—HUMBOLDT *Cosmos*, vol. iii, p. 122. (H., 1897.)

3647. VIRTUE AMONG SAVAGES—*Names Wanting for Love and Gratitude.*—Neither faith, hope, nor charity enters into the virtues of a savage. The Sichuana language contains no expression for thanks; the Algonquin had no word for love; the Tinnè no word for beloved; mercy was with the North-American Indians a mistake, and peace an evil; theft, says Catlin, they "call capturing"; humility is an idea which they could not comprehend. Among the Koupouees the greatest misconduct, says Major McCulloch, "is to forgive an enemy, the first virtue is revenge."—AVEBURY *Prehistoric Times*, ch. 15, p. 541. (A., 1900.)

3648. VIRTUES, PATERNAL, DIFFERENT FROM MATERNAL—*As Necessary to the Race—Heredity Blends the Two.*—The acquisitions of the manly life are as necessary to human character as the virtues which gather their sweetness by the cradle; and these robuster elements—strength, courage, manliness, endurance, self-reliance—could only have been secured away from domestic cares. Apart from that, it was not necessary to put the father through the same mill as the mother. Whatever the mother gained would be handed on to her boys as well as to her girls, and with the law of heredity to square accounts, it was unnecessary for each of the two great sides of humanity to make the same investments. By one acquiring one set of virtues and the other another, the blend in the end would be the richer; and, without obliterating the eternal individualities of each, the measure of completeness would be gained more quickly for the race. Before heredity, however, could do its work upon the father a certain basis had to be laid. With his original habits he would squander the hereditary gains as fast as he received them, and unless some change was brought about in his mode of life the old wild blood in his veins would counteract the gentler influence, and leave all the mother's work in vain. Hence Nature had to set about another long and difficult process—to make the savage father a reformed character.—DRUMMOND *Ascent of Man*, ch. 9, p. 293. (J. P., 1900.)

3649. VIRULENCE OF BACTERIA INCREASED BY ASSOCIATION—*Banded Evils Most Deadly.*—The virulence of . . . bacteria is . . . increased by means of association. The *Bacillus coli* is an example; for, in conjunction with other organisms, this bacillus, altho normally present in health in the alimentary canal, is able to set up acute intestinal irritation, and various changes in the body of an inflammatory nature. It is not yet possible to say in what way or to what degree the association of bacteria influences their rôle. That is a problem for the future. But whilst we have examples of this association in streptococcus and the bacillus of diphtheria, *B. coli* and yeasts, tetanus and putrefactive bacteria, *Diplococcus pneumoniæ* and streptococcus, and association amongst the various suppurative organisms, we cannot doubt that there is an explanation to be found here of many hitherto unsolved results of bacterial action.—NEWMAN *Bacteria*, ch. 1, p. 32. (G. P. P., 1899.)

3650. VISIBLE VS. ACTUAL—*Other Worlds than Ours Like Lands Beyond the Sea.*—The world in which we live is a round ball of a determined magnitude, and occupies its own place in the firmament. But when we explore the unlimited tracts of that space which is everywhere around us, we meet with other balls of equal or superior magnitude, and from which our earth would either be invisible, or appear as small as any of those twinkling stars which are seen on the canopy of heaven. Why then suppose that this little spot, little at least in the immensity which surrounds it, should be the exclusive abode of life and of intelligence? What reason to think that those mightier globes which roll in other parts of

creation, and which we have discovered to be worlds in magnitude, are not also worlds in use and in dignity? Why should we think that the great Architect of Nature, supreme in wisdom as he is in power, would call these stately mansions into existence and leave them unoccupied? When we cast our eye over the broad sea, and look at the country on the other side, we see nothing but the blue land stretching obscurely over the distant horizon. We are too far away to perceive the richness of its scenery, or to hear the sound of its population. Why not extend this principle to the still more distant parts of the universe? What tho, from this remote point of observation, we can see nothing but the naked roundness of yon planetary orbs? Are we therefore to say that they are so many vast and unpeopled solitudes; that desolation reigns in every part of the universe but ours; that the whole energy of the divine attributes is expended on one insignificant corner of these mighty works; and that to this earth alone belongs the bloom of vegetation, or the blessedness of life, or the dignity of rational and immortal existence?—CHALMERS *Astronomical Discourses*, p. 21. (R. Ct., 1848.)

3651. ——— ——— *Stars Seem to Revolve around the Pole—The "Steadfast Polar Star" Changes Place in the Sky.*—If we watch the heavenly bodies for a few hours we shall always find them in motion, those in the east rising upwards, those in the south moving towards the west, and those in the west sinking below the horizon. We know that this motion is only apparent, arising from the rotation of the earth on its axis; but . . . we may speak of the motion as real. A few days' watching will show that the whole celestial sphere seems to revolve, as on an axis, every day. It is to this revolution, carrying the sun alternately above and below the horizon, that the alternations of day and night are due. The nature and effects of this motion can best be studied by watching the apparent movement of the stars at night. We should soon learn from such a watch that there is one point in the heavens, or on the celestial sphere, which does not move at all. In our latitudes this point is situated in the north, between the zenith and the horizon, and is called the pole. Around this pole, as a fixed center, all the heavenly bodies seem to revolve, each one moving in a circle, the size of which depends on the distance of the body from the pole. There is no star situated exactly at the pole, but there is one which, being situated little more than a degree distant, describes so small a circle that the unaided eye cannot see any change of place without making some exact and careful observation. This is therefore called the pole-star. . . . The altitude of the pole is equal to the latitude of the place.—NEWCOMB *Popular Astronomy*, pt. i, ch. 1, p. 9. (H., 1899.)

3652. VISION, BINOCULAR—*The Effect of Seeing with Two Eyes.*—In Nature we see every object with two eyes, each of which occupies a somewhat different standpoint in space. We therefore acquire two pictures of each separate object that we blend in our conception into one physical whole. That is why we see objects in Nature in so much greater relief than in painting.—KAAT *Leonardo da Vinci als Naturforscher.* (Translated for *Scientific Side-Lights.)*

3653. VISION, DEFECTIVE—*Color-blindness—Case of Dr. Dalton.*—The most interesting case of [color-blindness] is that of the celebrated chemical philosopher, Dr. Dalton, of England. He published an account of his own case and that of several others in the *Transactions* of the Manchester Society in 1794. Of the seven colors of the rainbow he could distinguish but two, yellow and blue; or at most, three, yellow, blue, and purple. He saw no difference between red and green; so that he thought the color of a laurel leaf the same as that of a stick of red sealing-wax. A story is told of his having, on one occasion, appeared at the Quaker meeting, of which he was a member, in the usual drab coat and small-clothes of the sect, with a pair of flaming red-colored stockings to match. Whatever may be the truth in reference to this story, we have the assertion of Professor Whewell that when Dr. Dalton was asked with what he would compare the scarlet gown with which he had been invested by the university, he pointed to the trees, and declared that he perceived no difference between the color of his robe and that of their foliage. —HENRY *Color Blindness (Scientific Writings,* vol. i, p. 236). (Sm. Inst., 1886.)

3654. VISION INDEPENDENT OF ARGUMENT OR CALCULATION—*Apparent and Real Size of Church Clock and Ball on Steeple.*—Vision requires to be convinced [through its own organs]. No assertion on the part of other people, no speculation or calculation is of influence in determining our perception, but only an association of ideas repeated over and over again. Isolated experiences, therefore, make no impression upon our minds. From a window in my room I look directly upon a neighboring church tower. The face of the church clock appears about as large as that of a moderately large clock which hangs upon my wall. The ball of the steeple looks about as large as the button of a flagstaff. A little while ago the clock face and steeple knob were taken down for repairs and lay upon the street. To my astonishment, I saw that the former was as large as a church door, and the latter as large as a wagon-wheel. Now the two are in their places again and look to me just as they did before, altho I have learned their true size. The workman upon the roof does not seem so much smaller than he actually is, because I have observed

the size of my fellow men hundreds of times. But the ball of a steeple and a church clock are not objects of every-day experience. The button of a flagstaff and the clock on the wall are much more familiar. And so I think of the steeple knob as the flagstaff button, and the church clock as a wall clock. —WUNDT *Psychology,* lect. 2, p. 179. (Son. & Co., 1896.)

3655. VISION, NEW POSSIBILITIES OF—*Roentgen Rays Make the Opaque Transparent.*—These [Roentgen] rays are produced by a special form of electrical current sent through a vacuum tube, in or around which is some fluorescent substance, which under the action of the current becomes intensely luminous. But this luminosity has totally different properties from ordinary light, inasmuch as the substances which are opaque or transparent to it are not the same as those to which we usually apply the terms, but often the very contrary. Paper, for instance, is so transparent that the rays will pass through a book of a thousand pages, or through two packs of cards, both of which would be absolutely opaque to the most brilliant ordinary light. Aluminum, tin, and glass of the same thickness are all transparent, but they keep out a portion of the rays; whereas platinum and lead are quite opaque. To these rays aluminum is two hundred times as transparent as platinum. Wood, carbon, leather, and slate are much more transparent to the X-rays than is glass, some kinds of glass being almost opaque, tho quite transparent to ordinary light.—WALLACE *The Wonderful Century,* ch. 5, p. 39. (D. M. & Co., 1899.)

3656. VISION, REMARKABLE ADJUSTMENTS FOR—*The Eye Surpasses the Camera.*—As an optical instrument, the eye is superior to the camera in the following, among many other particulars, which may be enumerated in detail: 1. The correctness of images even in a large field of view. 2. The simplicity and efficiency of the means by which chromatic aberration is avoided. 3. The perfect efficiency of its adaptation to different distances. In the photographic camera it is well known that only a comparatively small object can be accurately focused. In the photograph of a large object near at hand the upper and lower limits are always more or less hazy, and vertical lines appear curved. This is due to the fact that the image produced by a convex lens is really slightly curved and can only be received without distortion on a slightly curved concave screen, hence the distortion on a flat surface of ground glass. It is different with the eye, since it possesses a concave background, upon which the field of vision is depicted, and with which the curved form of the image coincides exactly. Thus the defect of the camera obscura is entirely avoided, for the eye is able to embrace a large field of vision, the margins of which are depicted distinctly and without distortion. If the retina had a plane surface like the ground-glass plate in a camera, it must necessarily be much larger than is really the case if we were to see as much; moreover, the central portion of the field of vision alone would give a good, clear picture.—BERNSTEIN, quoted by BAKER in *Handbook of Physiology,* vol. ii, ch. 19, p. 213. (W. W., 1885.)

3657. VISIONS, DREADFUL, IN ALCOHOLIC MANIA—*Reptiles and Specters Seen—Delirium Tremens.*—This state [delirium tremens], which constitutes a connecting link between intoxication and insanity, seems rather to arise from perverted and imperfect nutrition of the brain than from poisoning of the blood; for it may be produced by other agencies which depress the nervous power, such as great loss of blood, the shock of severe injuries, or extreme cold. It is characterized by a low, restless activity of the cerebrum, manifesting itself in muttering delirium, with occasional paroxysms of greater violence; and the nature of this delirium almost always shows the mind of the subject of it to be possessed with the apprehension of some direful calamity. He imagines his bed to be covered with loathsome reptiles; he sees the walls of his apartment covered with foul or terrific specters; and he supposes the friends or attendants who stand around to be fiends come to drag him down into a fiery abyss beneath. Here we have, as in the case of false perceptions, . . . a misinterpretation of actual sense-impressions, under the influence of a dominant emotional state.—CARPENTER *Mental Physiology,* bk. ii, ch. 17, p. 656. (A., 1900.)

3658. VISIONS OF SCIENCE—*Conscious of Its Own Incompleteness—Hopeful of Mastery.*—From what has been said, it will be seen that tho a considerable amount of knowledge has been obtained respecting bacteria in the soil, it may be conjectured that actually there is still a great deal to ascertain before the microbiology of soil is in any measure complete or even intelligent. The mere mention of tetanus and typhoid in the soil, and their habits, nutriment, and products therein, not to mention the work of the economic bacteria, is to open up to the scientific mind a vast realm of possibility. It is scarcely too much to say that a fuller knowledge of the part which soil plays in the culture and propagation of bacteria may suffice to revolutionize the practise of preventive medicine. Truly, our knowledge at the moment is rather a heterogeneous collection of isolated facts and theories, some of which, at all events, require ample confirmation; still, there is a basis for the future which promises much constructive work.—NEWMAN *Bacteria,* ch. 5, p. 177. (G. P. P., 1899.)

3659. VISITORS FROM THE STARS —*The Lenarto Meteor under Chemical Analysis—Must Have Come from a Star Whose Atmosphere Is Dense with Hydrogen—Comets Originally Expelled from Sun or Star.*—Professor Graham, the late Master of the Mint, and one of the greatest chemists of our day, examined the iron of an aerolite, called the Lenarto meteor from the place where it fell. He tested it with special reference to the quantity of hydrogen contained in it; for hydrogen and other gases can be occluded, as it is called, or, as it were, closed in within the substance of iron. Now observe what he says about the iron of this meteor: "It has been found difficult to impregnate malleable iron with more than an equal volume of hydrogen under the pressure of our atmosphere. Now, the meteoric iron (this Lenarto iron is remarkably pure and malleable) gave up about three times that amount without being fully exhausted. The inference is that the meteorite *had been extruded from a dense atmosphere of hydrogen gas,* for which we must look beyond the light cometary matter floating about within the limits of our solar system. . . . Hydrogen has been recognized by the spectrum analysis of the light of the fixed stars by Messrs. Huggins and Miller. The same gas constitutes, according to the wide researches of Father Secchi, the principal element of a numerous class of stars, of which Alpha Lyræ (the leading brilliant of the Lyre) is the type. The iron of Lenarto has no doubt come from such an atmosphere, in which hydrogen greatly prevailed. *This meteorite may be looked upon as holding imprisoned within it, and bearing to us, the hydrogen of the stars.*"

We are led, then, to the startling conclusion that comets (for what applies to the meteoric trains must needs apply to the comets whence those trains proceed) have been expelled either from our sun or from one or other of the stars.—PROCTOR *Expanse of Heaven*, p. 146. (L. G. & Co., 1897.)

3660. VISITS OF CEREMONY AMONG BIRDS—*The South-American Lapwing.*—If a person watches any two birds [South-American lapwings] for some time—for they live in pairs—he will see another lapwing, one of a neighboring couple, rise up and fly to them, leaving his own mate to guard their chosen ground; and instead of resenting this visit as an unwarranted intrusion on their domain, as they would certainly resent the approach of almost any other bird, they welcome it with notes and signs of pleasure. Advancing to the visitor, they place themselves behind it; then all three, keeping step, begin a rapid march, uttering resonant, drumming notes in time with their movements, the notes of the pair behind being emitted in a stream, like a drum-roll, while the leader utters loud single notes at regular intervals. The march ceases; the leader elevates his wings and stands erect and motionless, still uttering loud notes, while the other two, with puffed-out plumage and standing exactly abreast, stoop forward and downward until the tips of their beaks touch the ground, and, sinking their rhythmical voices to a murmur, remain for some time in this posture. The performance is then over and the visitor goes back to his own ground and mate, to receive a visitor himself later on.—HUDSON *Naturalist in La Plata*, ch. 19, p. 269. (C. & H., 1895.)

3661. VITALITY, ENDURING, OF TYPHOID BACILLUS IN SOIL—*Frost and Snow Powerless to Destroy.*—Dr. Robertson [has made] admirable researches into the growth of the bacillus of typhoid in soil. By experimental inoculation of soil with broth cultures he was able to isolate the bacillus twelve months after, alive and virulent. He concludes that the typhoid organism is capable of growing very rapidly in certain soils, and under certain circumstances can survive from one summer to another. The rains of spring and autumn or the frosts and snows of winter do not kill them off so long as there is sufficient organic pabulum. Sunlight, the bactericidal power of which is well known, had, as would be expected, no effect except upon the bacteria directly exposed to its rays. The *bacillus typhosus* quickly dies out in the soil of grass-covered areas. Dr. Robertson holds that the chief channel of infection between typhoid-infected soil and man is dust. As in tubercle and anthrax, so in typhoid, dried dust or excreta containing the bacillus is the vehicle of disease.—NEWMAN *Bacteria*, ch. 5, p. 176. (G. P. P., 1899.)

3662. VITALITY LOWERED—*Gives Foothold to Disease—Effect of Sewer-gas.*—Tho not of material importance as regards bacterial treatment of sewage, this subject calls for some remark. For long it has been known that air polluted by sewage emanations is capable of giving rise to various degrees of ill health. These chiefly affect two parts of the body: one is the throat, and the other is the alimentary canal. Irritation and inflammation may be set up in both by sewer-air. Such conditions are in all probability produced by a lowering of the resistance and vitality of the tissues, and not by either a conveyance of bacteria in sewer-air or any stimulating effect upon bacteria exercised by sewer-air. What evidence we have is against such factors.—NEWMAN *Bacteria*, ch. 2, p. 87. (G. P. P., 1899.)

3663. VIVIDNESS OF MEMORY SUGGESTS NEARNESS IN TIME—*A Corrective in Recalling Intervening Events.*—Sometimes pictures of very remote incidents may suddenly present themselves to our minds with a singular degree of brightness and force. And when this is the case there is a disposition to think of them as near. If

the relations of the event to other events preceding and succeeding it are not remembered, this momentary illusion will persist. We have all heard persons exclaim, "It seems only yesterday," under the sense of nearness which accompanies a recollection of a remote event when vividly excited. The most familiar instance of such lively reproduction is the feeling which we experience on revisiting the scene of some memorable event. At such a time the past may return with something of the insistence of a present perceived reality.—SULLY *Illusions*, ch. 10, p. 257. (A., 1897.)

3664. VOID, SENSE OF, FROM LACK OF CUSTOMARY SOUND—*Facts in Consciousness, but Unheeded.*—When we first come out of a mill or factory, in which we have remained long enough to get wonted to the noise, we feel as if something were lacking. Our total feeling of existence is different from what it was when we were in the mill. . . . A friend writes to me: "I have in my room a little clock which does not run quite twenty-four hours without winding. In consequence of this, it often stops. So soon as this happens I notice it, whereas I naturally fail to notice it when going. When this first began to happen there was this modification: I suddenly felt an undefined uneasiness or sort of void, without being able to say what was the matter; and only after some consideration did I find the cause in the stopping of the clock.—C. E. MÜLLER, quoted by JAMES in *Psychology*, vol. i, ch. 11, p. 456. (H. H. & Co., 1899.)

3665. VOLCANO AND EARTHQUAKE IN CONJUNCTION—It is a very general opinion that earthquakes and volcanoes have a common origin; for both are confined to certain regions, altho the subterranean movements are least violent in the immediate proximity of volcanic vents, especially where the discharge of aeriform fluids and melted rock is made constantly from the same crater.—LYELL *Principles of Geology*, bk. ii, ch. 22, p. 245. (A., 1854.)

3666. ———— *Shock and Eruption Simultaneous.*—One of the earliest records of a severe earthquake and a volcanic eruption occurring simultaneously is found in the accounts of the destruction of Herculaneum and Pompeii. The throwing-up of Monte Nuovo in the neighborhood of Pozzuoli was accompanied with a dreadful earthquake. At the time of the eruptions of Kilauea in 1789 the ground shook and rocked so that persons could not stand. The first eruption of the volcano Irasu, in Costa Rica (1783), was accompanied by violent earthquakes. The smoke and flames which are said to have issued from the side of Mount Fojo at the time of the Lisbon earthquake are regarded by some as having been volcanic. Others thought that the phenomena, rather than being on the side of Fojo, which showed no traces of volcanic action, had taken place in the ocean. At the time of the great earthquake at Concepcion (1835), whilst the waves were coming in, two great submarine eruptions were observed. One, behind the isle of Quiriquina, appeared like a column of smoke. The other, in the bay of San Vicente, appeared to form a whirlpool. The sea-water became black, and had a sulfurous smell, there being a vast eruption of gas in bubbles. Many fish were killed. With this same earthquake, near to Juan Fernandez, about one mile from the shore, the sea appeared to boil, and a high column of smoke was thrown into the air. At night flames were seen.

In 1861, when Mendoza was destroyed and 10,000 inhabitants killed, a volcano at the foot of which Mendoza is situated burst into eruption.—MILNE *Earthquakes*, ch. 16, p. 274. (A., 1899.)

3667. VOLCANO, PROBLEMS OF THE—*A Fiery Flood—Waves Hardened into Rock.*—The lava-streams of active volcanoes, those last stragglers of the preceding powerful product of volcanic action, still contain unsolved problems for geology and mineralogy. We behold the lava breaking forth from the crater, and the mass of fire congealing into stone. Biased by the prevailing error that we understand what is being formed before our eyes, we suppose that we understand the formation of the lava rock. But, in fact, we are still far from such insight. The lava flowing almost without sound from the crevices, in a tough, heavy stream, already contains completely formed crystals. It gradually congeals, carrying flakes like a stream of ice. The quiet flow of the lava at its egress is in peculiar contrast to the racket and noise the stream makes in its progress and near to its end. Finally it becomes a wild aggregate, a procession of hills of glowing blocks of rock, propelled and rolled forward by an invisible hand. It is not a simple consolidation of homogeneous masses; steam and gases are active meanwhile, chemical processes are taking place. The glowing fire gradually disappears, but while the mass solidifies and crystallizes heat is again liberated, and the chemical processes may long continue after everything upon the surface of the mighty stream may be rigid and seemingly dead.—RATH *Der Vesuv, eine geologische Skizze*, in *Virchow und Holtzendorff's Sammlung gemeinverständlicher wissenschaftlicher Vorträge (Serie viii*, p. 671). (Translated for *Scientific Side-Lights.)*

3668. VOLCANO, QUIESCENT—*Delusive Repose—A Century of Quiet—Sudden Eruption.*—For nearly a century after the birth of Monte Nuovo, Vesuvius continued in a state of tranquillity. There had been no violent eruption for 492 years, and it appears that the crater was then exactly in the condition of the present extinct volcano of Astroni, near Naples. Bracini, who

visited Vesuvius not long before the eruption of 1631, gives the following interesting description of the interior: "The crater was five miles in circumference, and about a thousand paces deep; its sides were covered with brushwood, and at the bottom there was a plain on which cattle grazed. In the woody parts wild boars frequently harbored. In one part of the plain, covered with ashes, were three small pools, one filled with hot and bitter water, another salter than the sea, and a third hot, but tasteless." But at length these forests and grassy plains were consumed, being suddenly blown into the air, and their ashes scattered to the winds. In December, 1631, seven streams of lava poured at once from the crater, and overflowed several villages, on the flanks and at the foot of the mountain. Resina, partly built over the ancient site of Herculaneum, was consumed by the fiery torrent. Great floods of mud were as destructive as the lava itself—no uncommon occurrence during these catastrophes; for such is the violence of rains produced by the evolutions of aqueous vapor that torrents of water descend the cone, and becoming charged with impalpable volcanic dust, and rolling along loose ashes, acquire sufficient consistency to deserve their ordinary appellation of "aqueous lavas."—LYELL *Principles of Geology*, bk. ii, ch. 23, p. 374. (A., 1854.)

3669. VOLCANO RENDERS SERVICE TO MAN—*Buildings Cemented with Mortar from Depths of the Earth.*—The quantity of rain which falls during volcanic eruptions is often enormous, owing to the condensation of the great volumes of steam emitted from the vent. Consequently the falling lapilli and dust often descend upon the mountain, not in a dry state, but in the condition of a muddy paste. Many volcanic mountains have evidently been built up by the flow of successive masses of such muddy paste over their surfaces. Some volcanic materials when mixed with water have the property of rapidly "setting" like concrete. The ancient Romans and modern Italians, well acquainted with this property of certain kinds of volcanic dust and lapilli, have in all ages employed this "puzzolana," as it is called, as mortar for building.—JUDD *Volcanoes*, ch. 4, p. 89. (A., 1899.)

3670. VOLCANO TURNS FRUITFUL LAND INTO BARRENNESS—*Irredeemable Sterility of Lava-stream.*—In the year 1302 [occurred the eruption] of a lava-stream from a new vent on the southeast end of the island of Ischia. During part of 1301 earthquakes had succeeded one another with fearful rapidity; and they terminated at last with the discharge of a lava-stream from a point named the Campo del Arso, not far from the town of Ischia. This lava ran quite down to the sea—a distance of about two miles; in color it varies from iron-gray to reddish black, and is remarkable for the glassy feldspar which it contains. Its surface is almost as sterile, after a period of five centuries, as if it had cooled down yesterday. A few scantlings of wild thyme, and two or three other dwarfish plants, alone appear in the interstices of the scoriæ, while the Vesuvian lava of 1767 is already covered with a luxuriant vegetation. Pontanus, whose country-house was burnt and overwhelmed, describes the dreadful scene as having lasted two months. Many houses were swallowed up, and a partial emigration of the inhabitants followed.—LYELL *Principles of Geology*, bk. ii, ch. 22, p. 365. (A., 1854.)

3671. VOLCANOES EARTH'S SAFETY-VALVES—*Rocks Crumpled Like Tissue-paper by Internal Forces.*—No one who has not studied the crushed, crumpled, fractured, and altered condition of many of the sedimentary rocks of the globe can form the faintest idea of the enormous effects of the internal forces which have been in operation within the earth's crust during earlier geological periods. And it is only by such studies as these that we at last learn to regard the earthquake and volcanic phenomena of our globe, not as the grandest and most important effects of these forces, but as their secondary and accidental accompaniments. "Volcanoes," it has been said, "are the safety-valves of the globe"; and when we come to realize the real extent and nature of the internal forces ceaselessly working in the earth's crust we shall scarcely be disposed to regard the simile as an overstrained one.—JUDD *Volcanoes*, ch. 10, p. 289. (A., 1899.)

3672. VOLCANOES IN MINIATURE—*Imprisoned Steam Escaping from Sulfur.*—In the process of extracting sulfur from the residues obtained during the manufacture of soda, some very interesting phenomena are manifested. The molten sulfur is exposed to a temperature of 262° F. and a pressure of two or three atmospheres, in the presence of steam; under these circumstances it is found that the sulfur absorbs a considerable quantity of water, which is given off again with great violence from the mass as it undergoes solidification. The hardened crust which forms on the surface of the molten sulfur is agitated and fissured, miniature cones and lava-streams being formed upon it, which have a striking resemblance to the grander phenomena of the same kind exhibited upon the crust of the globe.—JUDD *Volcanoes*, ch. 12, p. 356. (A., 1899.)

3673. VOLCANOES, PRESENT NUMBER OF—*Seeming Quiescence Often Delusive.*—What is the number of volcanoes which are still vomiting forth lava during the present period of the earth's vitality? It is difficult to ascertain, for often mountains have seemed for a long time to be extinct; forests have grown up in their disused craters, and their beds of lava have been covered up under a rich carpet of vegetation,

when suddenly the sleeping force beneath is aroused and some fresh volcanic outlet is opened through the ground. When Vesuvius woke up from its protracted slumber, to swallow up Pompeii and the other towns lying round its base, it had rested for some centuries, and the Romans looked upon it as nothing but a lifeless mountain like the peaks of the Apennines. On the other hand, it is very possible that some craters from which steam and jets of gas are still escaping, or which have thrown out lava during the historic era, have entered decisively into a period of repose, ceasing somehow to maintain their communication with the subterranean center of molten matter. The number of vents which serve for the eruption of lava can therefore be ascertained in a merely approximate way. Humboldt enumerates 223 active volcanoes; Keith Johnson arrives at the larger number of 270 . . . ; but this latter estimate is probably too small.—RECLUS *The Earth*, pt. iv, ch. 62, p. 432. (H., 1871.)

3674. VOLITION A FORCE—*Will Draws on Latent Supplies in the Body—Application and Direction of Energy.*—Is there nothing in the human body to liberate it from that chain of necessity which the law of conservation coils around inorganic nature? Look at two men upon a mountainside, with apparently equal physical strength; the one will sink and fail, while the other scales the summit. Has not volition, in this case, a creative power? Physically considered, the law that rules the operations of a steam-engine rules the operations of the climber. For every pound raised by the former, an equivalent quantity of its heat disappears; and for every step the climber ascends an amount of heat, equivalent jointly to his own weight and the height to which it is raised, is lost to his body. The strong will can draw largely upon the physical energy furnished by the food; but it can create nothing. The function of the will is to apply and direct, not to create.—TYNDALL *Heat a Mode of Motion*, lect. 17, p. 531. (A., 1900.)

3675. VOLITION AS ESSENTIAL TO LIFE AS AUTOMATISM—*Man Has His Own Part to Play—Voluntary and Involuntary Processes Blend in Perfect Living.*—We find that in maintaining this natural life Nature has a share and man has a share. By far the larger part is done for us—the breathing, the secreting, the circulating of the blood, the building up of the organism. And altho the part which man plays is a minor part, yet, strange to say, it is not less essential to the well-being, and even to the being, of the whole. For instance, man has to take food. He has nothing to do with it after he has once taken it, for the moment it passes his lips it is taken in hand by reflex actions and handed on from one organ to another, his control over it, in the natural course of things, being completely lost. But the initial act was his. And without that nothing could have been done. Now whether there be an exact analogy between the voluntary and involuntary functions in the body and the corresponding processes in the soul we do not at present inquire. But this will indicate, at least, that man has his own part to play.—DRUMMOND *Natural Law in the Spiritual World*, essay 7, p. 228. (H. Al.)

3676. VOLITION INCARNATED IN THE BODY—*Habitual Voluntary Movements Become Automatic—The Motor Memory.*—Each time a voluntary action is performed, an impulse is discharged by the will to the muscles. . . . The mind being concerned with the execution of the movement, and not with the individual muscles, the further elaboration of the impulse is brought about by the ganglion cells of the motor memory centers.

Each time the higher faculties send impulses to several of these governing cells at once, an association is formed between them, resulting in a permanent modification of their constituent protoplasm. By repetition of the same movement, this association of the cells becomes stronger and stronger, until a very slight stimulus is required to bring about the movement.

It is this modification of their protoplasm and association of the cells which constitutes the motor memory. The motor memory thus bears the same relation to the outgoing impulses of the mind as the sensory memory does to the ingoing impressions. The motor memory has, therefore, only to do with voluntary movements, or movements which have been primarily voluntary, but have become secondarily reflex.—ELDRIDGE-GREEN *Memory and Its Cultivation*, pt. i, ch. 4, p. 25. (A., 1900.)

3677. VOLITION WEAKENED BY HASHISH—*Control and Coordination of Thought Lost.*—One of the first appreciable effects of the hashish is the gradual weakening of that power of volitionally controlling and directing the thoughts, which is so characteristic of the vigorous mind. The individual feels himself incapable of fixing his attention upon any subject; the continuity of his thoughts being continually drawn off by a succession of disconnected ideas, which force themselves (as it were) into his mind, without his being able in the least to trace their origin. These speedily engross his attention, and present themselves in strange combinations, so as to produce the most impossible and fantastic creations. By a strong effort of the will, however, the original thread of the ideas may still be recovered, and the interlopers may be driven away; their remembrance, however, being preserved, like that of a dream recalling events long since past. These lucid intervals become progressively of shorter dura-

tion, and can be less frequently procured by a voluntary effort.—CARPENTER *Mental Physiology,* bk. ii, ch. 17, p. 640. (A., 1900).

3678. VOYAGERS, AERIAL, UNSEEN—*Gossamer-spiders in Multitudes Floating through the Air.*—The gossamer-spider, most spiritual of living things, of which there are numerous species, some extremely beautiful in coloring and markings, is the most numerous of our spiders. Only when the declining sun flings a broad track of shiny silver light on the plain does one get some faint conception of the unnumbered millions of these buoyant little creatures busy weaving their gauzy veil over the earth and floating unseen, like an ethereal vital dust, in the atmosphere.—HUDSON *Naturalist in La Plata,* ch. 14, p. 184. (C. & H., 1895.)

3679. VOYAGERS, INVOLUNTARY—*Bees on Mountain Summit—Butterflies on Ship in South Sea.*—To the surprise of the adventurous travelers the summit of Fremont's Peak was found to be visited by bees. It is probable that these insects, like the butterflies which I found at far higher elevations in the chain of the Andes, and also within the limits of perpetual snow, had been involuntarily drawn thither by ascending currents of air. I have even seen large-winged lepidoptera, which had been carried far out to sea by land-winds, drop on the ship's deck at a considerable distance from land in the South Sea.—HUMBOLDT *Views of Nature,* p. 33. (Bell, 1896.)

3680. ——— ——— *Organisms Borne by Fallen Tree to Distant Lands.*—It is well known, from numerous examples, how far in many cases trunks of trees, hard-shelled fruits, and other not readily perishable portions of plants are carried away from their original home by the course of rivers and by the currents of the sea. Trunks of palm-trees from the West Indies are brought by the Gulf Stream to the British and Norwegian coasts. All large rivers bring down driftwood from the mountains, and frequently Alpine plants are carried from their home at the source of the river into the plains, and even further, down to the sea. Frequently numerous creatures live between the roots of the plants thus carried down; and between the branches of the trees thus washed away there are various inhabitants which have to take part in the passive migration. The bark of the tree is covered with mosses, lichens, and parasitic insects. Other insects, spiders, etc., even small reptiles and mammals, are hidden within the hollow trunk or cling to the branches. In the earth adhering to the fibers of the roots, in the dust lying in the cracks of the bark, there are innumerable germs of smaller animals and plants. Now, if the trunk thus washed away lands safely on a foreign shore or on a distant island, the guests who had to take part in the involuntary voyage can leave their boat and settle in the new country.—HAECKEL *History of Creation,* vol. i, ch. 14, p. 372. (K. P. & Co., 1899.)

3681. VOYAGES, TOO ADVENTUROUS—*Butterflies at Sea—Frail Creatures the Sport of the Elements.*—Several times when the ship has been some miles off the mouth of the Plata, and at other times when off the shores of Northern Patagonia, we have been surrounded by insects. One evening, when we were about ten miles from the Bay of San Blas, vast numbers of butterflies, in bands or flocks of countless myriads, extended as far as the eye could range. Even by the aid of a telescope it was not possible to see a space free from butterflies. The seamen cried out "it was snowing butterflies," and such in fact was the appearance. . . . The day had been fine and calm, and the one previous to it equally so, with light and variable airs. Hence we cannot suppose that the insects were blown off the land, but we must conclude that they voluntarily took flight. . . . Before sunset a strong breeze sprung up from the north, and this must have caused tens of thousands of the butterflies and other insects to have perished.—DARWIN *Naturalist's Voyage around the World,* ch. 8, p. 160. (A., 1898.)

3682. WAKEFULNESS PARTIAL AND CONTROLLED—*Mother Hears the Stirring of Her Babe—Does the Mind Sleep?*—The mother who is asleep to every sound but the stirrings of her babe evidently has the babe-portion of her auditory sensibility systematically awake. Relatively to that, the rest of her mind is in a state of systematized anesthesia. That department, split off and disconnected from the sleeping part, can none the less wake the latter up in case of need. So that on the whole the quarrel between Descartes and Locke as to whether the mind ever sleeps is less near to solution than ever. On a priori speculative grounds Locke's view that thought and feeling may at times wholly disappear seems the more plausible. As glands cease to secrete and muscles to contract, so the brain should sometimes cease to carry currents, and with this minimum of its activity might well coexist a minimum of consciousness. On the other hand, we see how deceptive are appearances, and are forced to admit that a part of consciousness may sever its connections with other parts and yet continue to be. On the whole it is best to abstain from a conclusion. The science of the near future will doubtless answer this question more wisely than we can now.—JAMES *Psychology,* vol. i, ch. 8, p. 213. (H. H. & Co., 1899.)

3683. WALKING AN INSTINCTIVE MOVEMENT—*Impulse Suddenly Developed in Human Beings.*—The walking instinct may awaken with [remarkable] suddenness, and its entire education be completed within a week's compass, barring, of course, a little "grogginess" in the gait. Individual in-

fants vary enormously; but on the whole it is safe to say that the mode of development of these locomotor instincts is inconsistent with the account given by the older English associationist school, of their being results of the individual's education. . . . [Persons] who have observed new-born calves, lambs, and pigs agree that in these animals the powers of standing and walking, and of interpreting the topographical significance of sights and sounds, are all but fully developed at birth. Often in animals who seem to be "learning" to walk or fly the semblance is illusive. The awkwardness shown is not due to the fact that "experience" has not yet been there to associate the successful movements and exclude the failures, but to the fact that the animal is beginning his attempts before the coordinating centers have quite ripened for their work.—JAMES *Psychology*, vol. ii, ch. 24, p. 405. (H. H. & Co., 1899.)

3684. WALKING SCIENTIFICALLY DESCRIBED—Walking is a continual falling forward.—KAAT *Leonardo da Vinci als Naturforscher.* (Translated for *Scientific Side-Lights.)*

3685. WANDERERS OF ANCIENT DAYS—*Boulders Carried Far by Ice—Northern Rocks on Western Prairies.*—The mineralogical character of the loose materials forming the American drift leaves no doubt that the whole movement [of the ancient glaciers], with the exception of a few local modifications easily accounted for by the lay of the land, was from north to south, all the fragments not belonging to the localities where they occur being readily traced to rocks *in situ* to the north of their present resting-places. The farther one journeys from their origin the more extraordinary does the presence of these boulders become. It strikes one strangely to find even in New England fragments of rock from the shores of Lake Superior; but it is still more impressive to meet with masses of northern rock on the prairies of Illinois or Iowa. One may follow these boulders to the fortieth degree of latitude, beyond which they become more and more rare, while the finer drift alone extends farther south.—AGASSIZ *Geological Sketches*, ser. ii, p. 84. (H. M. & Co., 1896.)

3686. WAR AMONG INSECTS—*Slave-making Ants Terrible in Battle—Prowess and Excellence Not Coextensive.*—*Polyergus rufescens*, the celebrated slave-making or Amazon-ant, has a mode of combat almost peculiar to herself. The jaws are very powerful, and pointed. If attacked—if, for instance, another ant seizes her by a leg—she at once takes her enemy's head into her jaws, which generally makes her quit her hold. If she does not, the *Polyergus* closes her mandibles, so that the points pierce the brain of her enemy, paralyzing the nervous system. The victim falls in convulsions, setting free her terrible foe. In this manner a comparatively small force of *Polyergus* will fearlessly attack much larger armies of other species, and suffer themselves scarcely any loss.—AVEBURY *Ants, Bees, and Wasps*, ch. 1, p. 18. (A., 1900.)

3687. WAR, FOREIGN MERCENARIES NO LONGER EMPLOYED IN—*Modern Standing Armies.*—Looking at the army system as it is in our modern world, one favorable change is to be noticed. The employment of foreign mercenary troops, which almost through the whole stretch of historical record has been a national evil alike in war and peace, is at last dying out. It is not so with the system of standing armies which drain the life and wealth of the world on a scale more enormous even than in past times, and stand as the great obstacle to harmony between nations. The student of politics can but hope that in time the pressure of vast armies kept on a war-footing may prove unbearable to the European nations which maintain them, and that the time may come when the standing army may shrink to a nucleus ready for the exigencies of actual war if it shall arise, while serving in peace-time as a branch of the national police.—TYLOR *Anthropology*, ch. 9, p. 228. (A., 1899.)

3688. WAR, THE FOLLY OF—*Relative Insignificance of the Earth in the Universe.*—Behold a little globe whirling in the infinite void. Round this globule vegetate 1,450 millions of so-called reasonable beings —or rather talkers—who know not whence they come nor whither they go, each of them, moreover, born to die very soon; and this poor humanity has resolved the problem, not of living happily in the light of Nature, but of suffering constantly both in body and mind. It does not emerge from its native ignorance, it does not rise to the intellectual pleasures of art and science, and torments itself perpetually with chimerical ambitions. Strange social organization! This race is divided into tribes subject to chiefs, and from time to time we see these tribes, afflicted with furious folly, arrayed against each other, obeying the signal of a handful of sanguinary evil-doers who live at their expense, and the infamous hydra of war mows down its victims, who fall like ripe ears of corn on the blood-stained fields. Forty millions of men are killed regularly every century in order to maintain the microscopical divisions of a little globule into several ant-hills.—FLAMMARION *Popular Astronomy*, bk. i, ch. 1, p. 12. (A.)

3689. WARFARE IN NATURE—*Animals Constructed for Others' Destruction.*—Very many animals contribute naturally to the destruction of caterpillars, spiders, and other insects. They lay their eggs in living caterpillars, which consequently become diseased and die either before or after their change into pupæ. Many also confine themselves to other species of their own genus, in whose bodies they lay their eggs,

so that, as Rolander has remarked of certain species, some appear to be created solely for the destruction of others.—BLUMENBACH *Manual of the Elements of Natural History*, p. 217.

3690. WASPS PROVIDING FOR THEIR OFFSPRING—*Prevision among Insects.*—The females of certain species of this genus *(Sphex)* dig a hole in sandy ground, drag a large spider, or the caterpillar of a *Phalœna*, into it, lame it by biting off its legs, and then lay an egg in each hole, so that the larva may suck the spinning-fluid from the animal the mother has buried, and by this means prepare for itself a habitation in which to pass through its metamorphosis. —BLUMENBACH *Manual of the Elements of Natural History*, p. 217.

3691. WASTE OF EARTH'S SURFACE REPAIRED—*Perpetual Reconstruction—A Necessity Early Discerned—Geology in the Eighteenth Century.*—Generelli [an Italian monk and philosopher, 1749] then describes the continual waste of mountains and continents by the action of rivers and torrents, and concludes with these eloquent and original observations: "Is it possible that this waste should have continued for six thousand and perhaps a greater number of years, and that the mountains should remain so great, unless their ruins have been repaired? Is it credible that the Author of Nature should have founded the world upon such laws as that the dry land should forever be growing smaller, and at last become wholly submerged beneath the waters? Is it credible that, amid so many created things, the mountains alone should daily diminish in number and bulk, without there being any repair of their losses? This would be contrary to that order of Providence which is seen to reign in all other things in the universe. Wherefore I deem it just to conclude that the same cause which, in the beginning of time, raised mountains from the abyss, has down to the present day continued to produce others, in order to restore from time to time the losses of all such as sink down in different places, or are rent asunder, or in other ways suffer disintegration. If this be admitted, we can easily understand why there should now be found upon many mountains so great a number of crustaceans and other marine animals."—LYELL *Principles of Geology*, bk. i, ch. 3, p. 37. (A., 1854.)

3692. WASTE OF THE EARTH'S CAPITAL—*Sewage and Garbage Thrown into the Sea—Stock of Fixed Nitrogen Finite.*—Sir William Crookes has recently pointed out the vast importance of using all the available nitrogen in the service of wheat production. The distillation of coal in the process of gas-making yields a certain amount of its nitrogen in the form of sulfate of ammonia, and this, like other nitrogenous manures, might be used to give back to the soil some of the nitrogen drained from it. But such manuring cannot keep pace, according to Sir W. Crookes, with the present loss of fixed nitrogen from the soil. We have already referred to several ways in which "loss" of nitrogen occurs. To these may well be added the enormous loss occurring in the waste of sewage when it is passed into the sea. . . . Let us remember that the plant creates nothing in this direction; there is nothing in wheat which is not absorbed from the soil, and unless the abstracted nitrogen is returned to the soil its fertility must be ultimately exhausted. When we apply to the land sodium nitrate, sulfate of ammonia, guano, and similar manurial substances, we are drawing on the earth's capital, and our drafts will not be perpetually responded to.—NEWMAN *Bacteria*, ch. 5, p. 160. (G. P. P., 1899.)

3693. WASTE, SEEMING, IN NATURE—*But One Seed among Thousands Grows—Progeny of One Orchid Would Cover the Earth.*—I was curious to estimate the number of seeds produced by some few orchids, so I took a ripe capsule of *Cephalanthera grandiflora*, and arranged the seeds on a long ruled line as equably as I could in a narrow hillock; and then counted the seeds in an accurately measured length of one-tenth of an inch. In this way the contents of the capsule were estimated at 6,020 seeds, and very few of these were bad; the four capsules borne by the same plant would have therefore contained 24,080 seeds. Estimating in the same manner the smaller seeds of *Orchis maculata*, I found the number nearly the same, viz., 6,200; and, as I have often seen above thirty capsules on the same plant, the total amount would be 186,300. As this orchid is perennial, and cannot in most places be increasing in number, one seed alone of this large number yields a mature plant once in every few years.*

To give an idea what the above figures really mean, I will briefly show the possible rate of increase of *O. maculata:* an acre of land would hold 174,240 plants, each having a space of six inches square, and this would be just sufficient for their growth; so that, making the fair allowance of 400 bad seeds in each capsule, an acre would be thickly clothed by the progeny of a single plant. At the same rate of increase the grandchildren would cover a space slightly exceeding the island of Anglesea; and the great grandchildren of a single plant would nearly (in the ratio of 47 to 50) clothe with one uniform green carpet the entire surface of the land throughout the globe. But the number of seeds produced by one of our common British orchids is as nothing compared to that of some of the exotic kinds.—DARWIN *Fertilization of Orchids*, ch. 9, p. 277. (A., 1898.)

* "And finding that of *fifty* seeds
She often brings but *one* to bear."
—TENNYSON *In Memoriam*, st. lv, ll. 11-12.

The poet's estimate is cautious and conservative, beside the studious computation of the man of science.

3694. ——— ——— *Seeds—Animals—Man.*—Altho astronomy, bringing us as it does in presence of the infinities of space, and indicating the operations of an infinity of force acting during infinite time, is of all others the science which seems to present to us the most striking instances of waste in Nature, it would yet be easy to cite many instances of seeming waste without leaving the teachings of our earth. How many seeds are scattered over the face of the earth to no visible purpose, for each one that falls on good ground and grows to perfection? How many creatures are brought to life that perish before they reach maturity? This, true of all races of animals, is true of man. True of the individual man, it is also true of nations, of races of men. History shows us, and we see in our own day, whole tribes of men disappearing without having reached that degree of civilization which we may regard as the measure of maturity in races and nations.—PROCTOR *Our Place among Infinities*, p. 40. (L. G. & Co., 1897.)

3695. ——— ——— *Sun's Heat Poured through Empty Space.*—Our earth receives less than the 2,000 millionth part of the heat and light emitted by the sun; all the planets together receive less than the 230 millionth part; the rest is seemingly scattered uselessly through the interstellar depths. To other worlds, circling around other suns, our sun may indeed appear as a star; but how minute the quantity of light and heat so received from him compared with the enormous quantity apparently wasted. The portion which seems squandered is scarcely affected at all by such small uses; and that portion is more than 230 millions of times as great as the portion used to warm and illuminate the solar system. And then consider what is the actual amount of energy thus seemingly wasted. I have computed (adopting Sir J. Herschel's estimate of the amount of heat poured by the sun upon each square mile of the earth's surface) that the sun emits in each second as much heat as would result from the burning of 11,600,000,000,000,000 tons of coal, and of this enormous amount of energy the portion utilized (that is, the heat received by the various members of the solar system) corresponds only to that due to the consumption of about 50 millions of tons—only 50 millions out of 11,600 millions of millions.—PROCTOR *Our Place among Infinities*, p. 42. (L. G. & Co., 1897.)

3696. WASTING OF THE MOUNTAINS—*Atmospheric Erosion of the Matterhorn.*—Standing on the *arête*, at the foot of a remarkable cliff gable seen from Zermatt, and permitting the vision to range over the Matterhorn, its appearance is exceedingly wild and impressive. Hardly two things can be more different than the two aspects of the mountain from above and below. Seen from the Riffel, or Zermatt, it presents itself as a compact pyramid, smooth and steep, and defiant of the weathering air. From above it seems torn to pieces by the frosts of ages, while its vast facets are so foreshortened as to stretch out into the distance like plains. But this underestimate of the steepness of the mountain is checked by the deportment of its stones. Their discharge along the side of the pyramid to-day was incessant, and at any moment, by detaching a single boulder, we could let loose a cataract of them, which flew with wild rapidity and with a thunderous clatter down the mountain. We once wandered too far from the *arête*, and were warned back to it by a train of these missiles sweeping past us.—TYNDALL *Hours of Exercise in the Alps*, ch. 24, p. 290. (A., 1898.)

3697. WATCHFULNESS OF MARMOTS—*Sociability in Hibernation.*—The European marmots of the Alps, we learn from Professor Blasius, "live high up in the snowy regions of the mountains, generally preferring exposed cliffs, whence they may have a clear view of any approaching danger, for which, while quietly basking in the sun, or actively running about in search of food, a constant watch is kept. When one of them raises the cry of warning, a loud piercing whistle well known to travelers in the Alps, they all instantly take to flight, and hide themselves in holes and crannies among the rocks, often not reappearing at the entrance of their hiding-place until several hours have elapsed, and then frequently standing motionless on the lookout for a still longer period. Their food consists of the roots and leaves of various Alpine plants, which, like squirrels, they lift to their mouths with their fore paws. For their winter quarters they make a large, round burrow, with but one entrance, and ending in a sleeping-place thickly lined with hay. Here from ten to fifteen marmots will often pass the winter, all lying closely packed together, fast asleep, until the spring."—MIVART *Types of Animal Life*, ch. 12, p. 353. (L. B. & Co., 1893.)

3698. WATER AN EXCEPTION TO LAW OF EXPANSION—*A Warning against Hasty Generalizations.*—A most valuable lesson as to the allowance we ought always to make for the unknown "possibilities of Nature" is taught us by an exceptional phenomenon so familiar that it does not attract the notice it has a right to claim. Next to the law of the universal attraction of masses of matter, there is none that seems to have a wider range than that of the expansion of bodies by heat and their contraction by cold. Excluding water and one or two other substances, the fact of such expansion might be said to be invariable; and, as regards bodies whose gaseous condition is known, the law of expansion can be stated in a form no less simple and definite than the law of gravitation. Supposing those exceptions, then, to be unknown, the law would be universal

in its range. But it comes to be discovered that water, whilst conforming to it in its expansion from 39½° upwards to its boiling-point, as also, when it passes into steam, to the special law of expansion of vapors, is exceptional in expanding also from 39½° downwards to its freezing-point; and of this failure in the universality of the law no rationale can be given.—CARPENTER *Nature and Man*, lect. 6, p. 207. (A., 1889.)

3699. WATER A POOR CONDUCTOR OF HEAT—*Solid Matter Hinders Diffusion.*—Count Rumford made a number of very amusing but also very important experiments on the diffusion of heat through liquids. He had frequently noticed to his cost the tenacity with which stewed apples retained their heat. "I never burned my mouth with them," he says, "without endeavoring, but in vain, to find out some way of accounting for this most surprising phenomenon." He noticed that the water of the volcanic bay of Baiæ was cold, while the sand on which the water lay was intolerably hot a few inches beneath the surface. Hence he concluded that water could not possess the power of conducting heat with which it was credited in his day. A sunbeam falling on a flask of heated alcohol, which he had placed in a window to cool, revealed to him, by the motion of floating particles, the convection currents of the liquid. His final inference was that it is solely by such currents that liquids distribute their heat, and that if these currents are impeded a proportionate retardation of the diffusion occurs. The fibrous part of apples he found to amount to only two per cent. of the whole, the rest being mainly water. Still this small modicum of solid matter so reduced the power of transferring heat that, while a thermometer surrounded by stewed apples required 535 seconds to be raised 80° F. in temperature, it required, when surrounded by water, only 172 seconds. Mixing 192 grains of starch with 2,276 grains of water, he found the convection so hampered by the starch that the heating of his thermometer 80° required 341 seconds of exposure, while when surrounded by pure water only 172 seconds were needed. The retention of heat by thick soup or chocolate is to be referred to the cause revealed by these experiments of Rumford.—TYNDALL *Heat a Mode of Motion*, lect. 8, p. 216. (A., 1900.)

3700. WATER A PROTECTION TO PLANTS—*Leaf-cups Stop Injurious Insects.*—In aquatic plants, of course, the access of ants is precluded by the isolation in water. Nay, even many land plants have secured to themselves the same advantage, the leaves forming a cup round the stem. Some species have such a leaf-cup at each joint; in others there is only a single basin, formed by the rosette of radical leaves. In these receptacles rain and dew not only collect, but are retained for a considerable time. In our own country *Dipsacus sylvestris* (the common teazel) is the best marked instance of this mode of protection, tho it is possible that these cups serve another purpose, and form, as suggested by Francis Darwin, traps in which insects are caught, and in which they are dissolved by the contained fluid, so as to serve as food for the plant. However this may be, the basins are generally found to contain water, even if no rain has fallen for some days, and must, therefore, serve to prevent the access of ants.—AVEBURY *Ants, Bees, and Wasps*, ch. 3, p. 52. (A., 1900.)

3701. WATER AS A MECHANICAL POWER—*The World's Progress Dependent on Water-power.*—If we were permitted to coin a word, we should call all the arts combined that relate to the getting, preserving, and utilizing of water, hydrotechny; but that would furnish rather a long term for the study of these arts—hydrotechnology—tho it is not lacking in euphony. The spring, the well, the city reservoir and water-works; the open stream, the canal, the locomotive; the tide-wheel, the overshot, the turbine—all of these indicate progress in hydrotechny as related to aliment, to transportation, to irrigation, and to manufactures. The world's progress has followed the water, and water has never been absent from men's minds.—MASON *Aboriginal American Mechanics* (*Memoirs of the International Congress of Anthropology*, p. 82). (Sch. P. C.)

3702. WATER CHANGING LEVEL—*Work Done on the Way—Energy of Position.*—An instance of energy of position may be found in a body of water having a level higher than that of the ocean's surface. If this body of water is released it will flow down to the lower level, and during its progress it is able to do work, such as grinding grain, sawing wood, or driving the machinery of a factory. When it has reached its lowest level it no longer possesses the power to do work. In order to restore to it the same power that it had at the higher level we should have to expend the same amount of energy in pumping it back that it gave up when it ran down. As a matter of fact we should have to expend a great deal more, because of the great amount of energy that would be lost in the form of friction in the machinery employed for the purpose.—ELISHA GRAY *Nature's Miracles*, vol. ii, ch. 2, p. 19. (F. H. & H., 1900.)

3703. WATER, COLOR OF, DUE TO FINELY DIVIDED MATTER—Absolutely pure water, like pure air, is colorless, but all seas and lakes, however clear and translucent, contain abundance of very finely divided matter, organic or inorganic, which, as in the atmosphere, reflects the blue rays in such quantity as to overpower the white or colored light reflected from the fewer and more rapidly sinking particles of larger size.—WALLACE *The Wonderful Century*, ch. 9, p. 75. (D. M. & Co., 1899.)

3704. WATER EXPANDS IN FREEZING—*Protection to Life in Lakes and Streams.* —"It does not appear to me," he [Count Rumford] writes, "that there is anything which human sagacity can fathom, within the wide-extended bounds of the visible creation, which affords a more striking or more palpable proof of the wisdom of the Creator, and of the special care he has taken in the general arrangement of the universe to preserve animal life, than this wonderful contrivance." Rumford's enthusiasm was excited by considerations like the following: Suppose a lake exposed to a clear, wintry sky. The superficial water is first chilled; it contracts, becomes heavier, and sinks by its superior weight, its place being taken by the lighter water from below. In time this is chilled and sinks in its turn. Thus a circulation is established, the cold, dense water descending, and the lighter and warmer water rising to the top. Supposing this to continue, even after the first pellicles of ice have been formed at the surface; the ice would sink, and the process would not cease until the entire water of the lake would be solidified. Death to every living thing in the water would be the consequence. But just when matters become critical, Nature, speaking poetically, steps aside from her ordinary proceeding, causes the water to expand by cooling, and the cold water to swim like a scum on the surface. Solidification ensues, but the solid is much lighter than the adjacent liquid, and the ice forms a protecting roof over the living things below.—TYNDALL *Heat a Mode of Motion*, lect. 4, p. 109. (A., 1900.)

3705. WATER HONEYCOMBS ROCKS FAR UNDER GROUND—*How Mineral Springs Are Formed.*—In the case of feldspathic rocks, it is found that some of the constituent minerals, more especially the feldspars, usually show traces of decomposition at depths of many feet or even yards below the weathered superficial portions. It is hard, indeed, to get a specimen of any such rock from the bottom of our deepest quarries which is perfectly fresh. Water soaks through interstitial fissures and pores, and finds its way by joints and other division-planes, so that chemical action, with resultant rock-decay, is carried on at the greatest depths to which water can penetrate. This underground water eventually comes to the surface again through similar joints, etc., opening upwards, and thus forms natural springs. All these springs contain mineral matter, derived from the chemical decomposition and solution of rock-constituents. Many, indeed, are so highly impregnated, that as soon as they are exposed to evaporation they begin to deposit some of their mineral matter. Thus vast quantities of rock-material are brought up from the bowels of the earth.—GEIKIE *Earth Sculpture*, ch. 2, p. 30. (G. P. P., 1898.)

3706. WATER IN MOUNTAIN LAKES UNFROZEN—*Uniform Temperature in the Depths.*—The temperature observations made in Lake Tahoe . . . furnish an illustration of the fact that deep lakes, even when situated at a high elevation and subject to low winter temperatures, do not freeze. The surface waters are cooled in winter and descend, while warmer waters from below rise and take their place, thus establishing a circulation; but the body of water is so great that its entire mass never becomes cooled sufficiently during the comparatively short winters to check the upward circulation and allow ice to form. At the greatest depth reached the temperature was 39.2° F., which is the temperature of fresh water at its maximum density; and from more extended observation in other lakes, the water is believed to retain this temperature throughout the year.—RUSSELL *Lakes of North America*, ch. 4, p. 64. (G. & Co., 1895.)

3707. WATER STORED IN THORNY PLANT—*A Reservoir for Thirsty Animals—Provision in Lower Organism for Needs of Higher—Cactus in South America.*—The cactus form . . . is almost peculiar to the new continent; it is sometimes globular, sometimes articulated, sometimes rising in tall, polygonal columns not unlike organ-pipes. This group forms the most striking contrast with the lily and banana families, and belongs to that class of plants which Bernardin de St. Pierre felicitously terms vegetable fountains of the desert. In the parched, arid plains of South America the thirsting animals eagerly seek the *Melocactus*, a globular plant half-buried in the dry sand, whose succulent interior is concealed by formidable prickles. The stems of the columnar cactus attain a height of more than 30 feet; their candelabra-like ramifications, frequently covered with lichens, reminding the traveler, by some analogy in their physiognomy, of certain of the African euphorbias.—HUMBOLDT *Views of Nature*, p. 220. (Bell, 1896.)

3708. WATER, TRANSLUCENCE OF—*Rich Color of Waves that Break in Foam.*—Nothing can be more superb than the green of the Atlantic waves when the circumstances are favorable to the exhibition of the color. As long as a wave remains unbroken no color appears, but when the foam just doubles over the crest like an Alpine snow-cornice, under the cornice we often see a display of the most exquisite green. It is metallic in its brilliancy. But foam is necessary to its production. The foam is first illuminated, and it scatters the light in all directions; the light which passes through the higher portion of the wave alone reaches the eye, and gives to that portion its matchless color. The folding of the wave, producing, as it does, a series of longitudinal protuberances and furrows, which

act like cylindrical lenses, introduces variations in the intensity of the light, and materially enhances its beauty.—TYNDALL *Lectures on Light*, lect. 1, p. 36. (A., 1898.)

3709. WATER, WONDERFUL TRANSFORMATION OF—*Feathery Lightness of Snow.*—We are all familiar with the way in which the flakes, in falling, are driven about by the slightest breath of air, and every one knows, likewise, that a handful of snow is perhaps as light a handful as one can lift. The actual weight of snow depends very much upon circumstances. Snow varies greatly in compactness, but on an average it is found that a cubic yard of this substance weighs about 187 lbs., or about one-twelfth of an equal bulk of water. Ice itself is lighter than water, but in nothing like the same proportion; and a certain volume of snow would, on an average, have only about one-eleventh of the weight of an equal volume of ice. No one will be at a loss to understand the reason for it; it is so manifest that snow in the mass consists of innumerable little spicules of ice interlaced together, and having a great quantity of air enclosed in the meshes, that the lightness of this substance when compared with ice or water will not excite any surprise.—CHISHOLM *Nature-Studies*, p. 29. (Hum., 1888.)

3710. WATERS CROWDED UPON WATERS—*The Whirlpool Rapids at Niagara —Illustration of Wave-action.*—The most impressive illustration of the action of waves on waves that I have ever seen occurs near Niagara. For a distance of two miles, or thereabouts, below the Falls, the river Niagara flows unruffled through its excavated gorge. The bed subsequently narrows, and the water quickens its motion. At the place called the "Whirlpool Rapids" I estimated the width of the river at 300 feet, an estimate confirmed by the dwellers on the spot. When it is remembered that the drainage of nearly half a continent is compressed into this space, the impetuosity of the river's escape through this gorge may be imagined. Two kinds of motion are here obviously active, a motion of translation and a motion of undulation—the race of the river through its gorge, and the great waves generated by its collision with the obstacles in its way. In the middle of the stream the rush and tossing are most violent; at all events, the impetuous force of the individual waves is here most strikingly displayed. Vast pyramidal heaps leap incessantly from the river, some of them with such energy as to jerk their summits into the air, where they hang suspended as bundles of liquid pearls, which, when shone upon by the sun, are of indescribable beauty.—TYNDALL *Lectures on Light*, lect. 2, p. 56. (A., 1898.)

3711. WATERS TRANSPORTING SEEDS—*Wind and Wave Combine to Plant the Sedge in New Locations.*—The most abundant plants in marshes and by pond-sides are the sedges. They resemble coarse grasses, for which they are frequently mistaken. Some of them have seeds adapted to wind-dispersal by means of cottony tufts of hairs; but most of them simply cast their seeds upon the quiet waters, where they float upon the surface and are driven along by every breath of wind. It will be worth your while to remove some "seed" of sedge from a ripened head and study its structure. As you pick up what appears to be the seed . . . you notice how little weight it has. On looking closer you are likely to see that it is triangular, in many species being shaped like a miniature beechnut. If you press upon it the "seed" breaks, and you find it apparently hollow on the inside. But if you look carefully you will see within a tiny body, which is really the seed. The other is simply an air-filled boat in which the seed remains. A seed with such an outer covering is called an achene, altho in most achenes there is not the air space which these sedges show. Now drop some of these sedge achenes upon the surface of water in a tumbler or other vessel. Do they sink? See them rest buoyantly upon the top, with one flat side down and the two other sides projecting upward. Blow gently across the water; see how quickly the tiny sails catch the breeze and the achenes move away. Fancy them upon a quiet pool out-of-doors: the wind ripples the surface and away they go to the other side, where they may find lodgment, or, perchance, if the pool has an outlet, they may be carried far away by the running water.—WEED *Seed Travelers*, pt. i, p. 26. (G. & Co., 1899.)

3712. WAVE-MOTION IS THE ADVANCE OF A FORM—*The Particles of Water Merely Rise and Fall.*—In the earliest writings of the ancients we find the notion that sound is conveyed by the air. Aristotle gives expression to this notion, and the great architect, Vitruvius, compares the waves of sound to waves of water. But the real mechanism of wave-motion was hidden from the ancients, and indeed was not made clear until the time of Newton. The central difficulty of the subject was to distinguish between the motion of the wave itself and the motion of the particles which at any moment constitute the wave.

Stand upon the seashore and observe the advancing rollers before they are distorted by the friction of the bottom. Every wave has a back and a front, and, if you clearly seize the image of the moving wave, you will see that every particle of water along the front of the wave is in the act of rising, while every particle along its back is in the act of sinking. The particles in front reach in succession the crest of the wave, and as soon as the crest is passed they begin to fall. They then reach the furrow or sinus of the wave, and can sink no farther. Immediately afterwards they become the front

of the succeeding wave, rise again until they reach the crest, and then sink as before. Thus, while the waves pass onward horizontally, the individual particles are simply lifted up and down vertically. Observe a sea-fowl, or, if you are a swimmer, abandon yourself to the action of the waves; you are not carried forward, but simply rocked up and down. The propagation of a wave is the propagation of a form, and not the transference of the substance which constitutes the wave.—TYNDALL *Lectures on Light*, lect. 2, p. 52. (A., 1898.)

3713. WAVES HEAVING EARTH'S CRUST IN EARTHQUAKE—*Trees Lashing Ground with Their Branches.*—The whole of the country over which the effects of the great shocks [of the Calabrian earthquake] extended was at times heaved simultaneously, like an angry sea, and sensations resembling seasickness were experienced by many of the inhabitants. Those who have watched the sky from the deck of a sea-tossed ship will have noticed that the drifting clouds seem at times to be arrested in their motion; it is in reality the ship which is moving for the moment in the same direction as the clouds, and thus neutralizes the effects of their motion. The same phenomenon was observed during the Calabrian earthquake; and nothing serves to give us a stronger impression of the turbulence of those internal heavings which make the dry land as unstable as the billows of a swelling sea. Trees whose roots continued firmly embedded in the soil were seen to lash the ground with their branches.—PROCTOR *Notes on Earthquakes*, p. 3. (Hum., 1887.)

3714. WAVES, INTERFERENCE OF—*The Whirlpool at Niagara—Motion Doubled or Annulled.*—The first impression, and, indeed, the current explanation of these rapids [of Niagara] is, that the central bed of the river is cumbered with large boulders, and that the jostling, tossing, and wild leaping of the water there are due to its impact against these obstacles. A very different explanation occurred to me upon the spot. Boulders derived from the adjacent cliffs visibly cumber the sides of the river. Against these the water rises and sinks rhythmically, but violently, large waves being thus produced. On the generation of each wave there is an immediate compounding of the wave-motion with the river-motion. The ridges, which in still water would proceed in circular curves round the center of disturbance, cross the river obliquely, and the result is that at the center waves commingle which have really been generated at the sides. This crossing of waves may be seen on a small scale in any gutter after rain; it may also be seen on simply pouring water from a wide-lipped jug. Where crest and furrow cross each other the wave is annulled; where furrow and furrow cross, the river is plowed to a greater depth; and where crest and crest aid each other we have that astonishing leap of the water which breaks the cohesion of the crests, and tosses them shattered into the air. The phenomena observed at the Whirlpool Rapids constitute, in fact, one of the grandest illustrations of the principle of interference.—TYNDALL *Lectures on Light*, lect. 2, p. 57. (A., 1898.)

3715. WAVES OF HEAT LIKE WAVES OF LIGHT—*Ethereal Billows Beat on Human Body.*—To the eye of the philosopher, looking at such matters without reference to sensation, these obscure radiations [of heat] are substantially the same in kind as those which produce the impression of light. You must, therefore, figure the molecules of the heated body as in a state of motion; you must figure that motion as communicated to the surrounding ether, and transmitted through it with a velocity which we have the strongest reason for believing to be the same as that of light. When, therefore, you turn towards a fire on a cold day and expose your chilled hands to its influence, the warmth which you feel is due to the impact of these ethereal billows upon your skin. They throw the nerves into motion, and the consciousness, corresponding to this motion, is what we popularly call warmth.—TYNDALL *Heat a Mode of Motion*, lect. 10, p. 276. (A., 1900.)

3716. WAVES OF LIGHT MORE RAPID AS HEAT MORE INTENSE—*Wire Passes from Red to White.*—A platinum wire [through which an electric current flows] is warmed by the current, and may be felt to be warm by the hand. It emits waves of heat, but no light. Augmenting the strength of the current, the wire becomes hotter; it finally glows with a sober red light. At this point Dr. Draper many years ago began an interesting investigation. He employed a voltaic current to heat his platinum, and he studied, by means of a prism, the successive introduction of the colors of the spectrum. His first color . . . was red; then came orange, then yellow, then green, and lastly all the shades of blue. Thus as the temperature of the platinum was gradually augmented, the atoms were caused to vibrate more rapidly; shorter waves were thus introduced, until finally waves were obtained corresponding to the entire spectrum.—TYNDALL *Lectures on Light*, lect. 5, p. 174. (A., 1898.)

3717. WAVES OF SEA AND LAND IN EARTHQUAKE—*Undulations Transmitted through Solid Bodies.*—Mr. Mallet, in his memoir [1846] . . . has endeavored to bring to bear on this difficult subject [of earthquake shocks] the more advanced knowledge obtained of late years respecting the true theory of waves. He conceives that when the origin of the shock is beneath the deep ocean one wave is propagated through the land, and another moving with inferior velocity is formed on the surface of the ocean. This last rolls in upon the

land long after the earth wave has arrived and spent itself. However irreconcilable it may be to our common notions of solid bodies, to imagine them capable of transmitting, with such extreme velocity, motions analogous to tidal waves, it seems nevertheless certain that such undulations are produced, and it is supposed that when the shock passes a given point each particle of the solid earth describes an ellipse in space. The facility with which all the particles of a solid mass can be made to vibrate may be illustrated, says Gay-Lussac, by many familiar examples. If we apply the ear to one end of a long wooden beam, and listen attentively when the other end is struck by a pin's head, we hear the shock distinctly, which shows that every fiber throughout the whole length has been made to vibrate. The rattling of carriages on the pavement shakes the largest edifices; and in the quarries underneath some quarters in Paris it is found that the movement is communicated through a considerable thickness of rock.—LYELL *Principles of Geology*, bk. ii, ch. 29, p. 498. (A., 1854.)

3718. WEALTH OF CELESTIAL BEAUTY—*The Stars Repeat the Lesson of the Lilies (Matt. vi, 28-29).*—I conceive that few thoughts can be more striking and instructive than those suggested by this infinite wealth of beauty and variety [among the double stars and the star-clusters of the sky]. We see throughout the whole universe the same splendor on a large scale which is bestowed on a small scale upon the flowers of the field, which "toil not, neither do they spin, yet Solomon in all his glory was not arrayed like one of these."—PROCTOR *Expanse of Heaven*, p. 237. (L. G. & Co., 1897.)

3719. WEAPON AND TOOL—*Knife or Dagger.*—Among implements used by man, the same forms may sometimes be employed for destruction and at other times for industrial purposes. When used for destruction they are weapons, but when their function is industrial they are tools. The same object, when used as a weapon, becomes a dagger, but if it be employed as an edged tool it is a knife. As in the case of all other weapons or tools, the edged tool works by pressure, by friction, or by a blow. One used by means of a blow is an ax if the edge is in a line with the handle, and an adz if it lies across the handle; an edged tool working by friction is a scraper, but one working by pressure is a knife.—MASON *The Man's Knife among the North American Indians (Report of the U. S. National Museum for 1897*, p. 727).

3720. WEAPONS IMPROVISED—*Armadillo Saws Snake with Its Shell.*—A friend of mine, a careful observer, who was engaged in cattle-breeding amongst the stony sierras near Cape Corrientes, described to me an encounter he witnessed between an armadillo and a poisonous snake. While seated on the hillside one day he observed a snake, about twenty inches in length, lying coiled up on a stone five or six yards beneath him. By and by, a hairy armadillo appeared trotting directly towards it. Apparently the snake perceived and feared its approach, for it quickly uncoiled itself and began gliding away. Instantly the armadillo rushed on to it, and squatting close down, began swaying its body backward and forward with a regular sawing motion, thus lacerating its victim with the sharp, deep-cut edges of its bony covering. The snake struggled to free itself, biting savagely at its aggressor, for its head and neck were disengaged. Its bites made no impression, and very soon it dropped its head, and when its enemy drew off it was dead and very much mangled.—HUDSON *Naturalist in La Plata*, ch. 4, p. 72. (C. & H., 1895.)

3721. WEAPONS, POISONED, IN ANCIENT TIMES—*Reprobation of the Custom in Homer—Its Prevalence in Middle Ages—Also among Modern Savages.*—The daubing on of venom to make them [offensive weapons] more deadly is found among low tribes far over the world. Thus the bushman mixes serpent's poison with the euphorbia juice, and the South-American native poison-maker, prepared by a long fast for the mysterious act, concocts the paralyzing urari, or curare, in the secret depths of the forest, where no woman's eye may fall on the fearful process. Poisoned arrows were known to the ancient world, as witness the lines which tell of Odysseus going to Ephyra for the man-slaying drug to smear his bronze-tipped arrows; but Ilos would not give it, for he feared the ever-living gods. Thus it seems that in early ages the moral sense of the higher nations had already condemned the poisoned weapons of the savage with something of the horror Europeans now feel in examining the Italian bravo's daggers of the Middle Ages, with their poison-grooves imitated from the serpent's tooth. —TYLOR *Anthropology*, ch. 9, p. 221. (A., 1899.)

3722. WEAVING INVENTED BY PRIMITIVE WOMEN—*Styles Transported over the World.*—There is no work of woman's fingers that furnishes a better opportunity for the study of techno-geography, or the relationship existing between an industry and the region where it may have been developed, than the textile art. Suppose a certain kind of raw material to abound in any area or country: you may be sure that savage women searched it out and developed it in their crude way. Furthermore, the peculiar qualities and idiosyncrasies of each substance suggest and demand a certain treatment. Women of the lowest grades of culture have not been slow in discovering this; so that between them and the natural product there has been a kind of understanding or co-

operation leading to local styles. If these women were moved far away, they carried oftentimes these processes with them, and plied the old trade upon such strange materials as they discovered in their new home. —MASON *Woman's Share in Primitive Culture,* ch. 3, p. 41. (A., 1894.)

3723. WEAVING OF THE SPIDER —*Fluid Silk Hardening by Exposure to the Air.*—Like the silk-moth's caterpillar, or the mussel in the sea, which are also spinners and weavers, Madame Spider's silk-secretion exists within her body in a fluid state. It is made and secreted by certain silk-forming glands which end in the "spinnerets." These last are conical projections placed near the tail; and comparative anatomy seems to teach us that the spinnerets really represent much-altered limbs. Each of these organs seems in its essential nature to be composed of a multitude of fine tubes, opening at the top of the spinneret. This, then, is the apparatus wherewith our spider weaves.

Let us see how the weaving is carried on. The silk, while within the glands, exists in a semifluid state; but when it is exposed to the air it becomes dried, or of a more tenacious consistency, and in this state is susceptible of being drawn out into a fine thread. Think for a moment what happens to melted wax or glue. So long as the heat is of sufficient amount either substance remains fluid; but if we draw a little out of the pot on a piece of stick, exposure to the air hardens the wax or glue, and with a little dexterity we can produce the melted substance into a fine thread. This represents accurately enough how and why the semifluid silk of the spider becomes a dry thread when it is pressed out through the fine tubes of the spinnerets. — WILSON *Glimpses of Nature,* ch. 6, p. 23. (Hum., 1892.)

3724. WEIGHT BALANCED AGAINST DISTURBING FORCE—*The Spider's Knowledge of Mechanics.*—Practical acquaintance with mechanical principles . . . is sometimes shown by spiders when they find that a widely spread web is not tightly enough stretched, and as a consequence is to an inconvenient extent swayed about by the wind. Under such circumstances these animals have been observed to suspend to their webs small stones or other heavy objects, the weight of which serves to steady the whole system. Gleditsch saw a spider so circumstanced let itself down to the ground by means of a thread, seize a small stone, remount, and fasten the stone to the lower part of its web, at a height sufficient to enable animals and men to walk beneath it. —ROMANES *Animal Intelligence,* ch. 6, p. 220. (A., 1899.)

3725. WEIGHT OF THE SUN—*Density One-fourth That of Earth—Mass Not Proportioned to Size.*—We now know that the sun's average distance from the earth is about 93,000,000 miles, and consequently that his diameter is about 865,000 miles. The sun has been weighed against the earth and found to contain a quantity of matter nearly 330,000 times as great, and comparing this with his enormous bulk, it appears that his mean density is only about one-fourth that of the earth, or one and a quarter times that of water—in other words, the mass of the sun is about one-fourth greater than that of a globe of water of the same size.—YOUNG *The Sun,* int., p. 7. (A., 1898.)

3726. WHEEL, THE, A PREHISTORIC INVENTION—*The Primitive Farm-cart—War-chariots with Spoke-wheels in Ancient Egypt—Railway Wheels and Axles Return to Primitive Type.*—The wheel-carriage, which is among the most important machines ever contrived by man, must have been invented in ages before history. To see what constructive skill the leading nations had already attained to in times we reckon as of high antiquity, it is worth while to examine closely the Egyptian war-chariots, with their neatly-fitted and firmly-tired spoke-wheels turning on their axles secured by linchpins, while the body, pole, and double harness show equal technical skill. In looking for some hint as to how wheel-carriages came to be invented, it is of little use to judge from such high skilled work as was turned out by these Egyptian chariot-builders, or by the Roman *carpentarii* or carriage-builders from whom our *carpenters* inherit their name. But as often happens, rude contrivances may be found which look as tho they belonged to the early stages of the invention. The *plaustrum* or farm-cart of the ancient world in its rudest form had for wheels two solid wooden drums near a foot thick, and made from a tree-trunk cut across, which drums or wheels did not turn on the axle, but were fixed to it; the axle was kept in place by wooden stops, or passed through rings at the bottom of the cart, and went round together with its pair of wheels, as children's toy carts are made. It is curious to notice how, under changed conditions, the builders of railway carriages have returned to this early construction. . . . In such countries as Portugal the old classic bullock-cart on this principle is still to be seen, and it has been reasonably guessed that such carts tell the story how wheel-carriages came to be invented.—TYLOR *Anthropology,* ch. 8, p. 198. (A., 1899.)

3727. WHEELS FOR VEHICLES UNKNOWN IN AMERICA BEFORE COLUMBUS—*The Fly-wheel for Spindles and Drills.* —There was nothing on the continent that could be compared to a wheel, either for carriage or for mechanical purposes, when Columbus discovered America. The fly-wheel was well known and widely distributed on spindles and drills, but there were no wheel-barrows, carts or carriages, no cranks, or windlasses, or capstans. But the Alaskan Indians, and perhaps others, used the parbuckle, which combines the roller and the

pulley in the same device. For hoisting logs, a rope was fastened to the tops of posts, passed down under a log in the ground, back over the top of the post, and down to the ground, where it was seized by men. —MASON *Aboriginal American Mechanics (Memoirs of the International Congress of Anthropology*, p. 76). (Sch. P. C.)

3728. WHIRLWIND AS OBSERVED BY FRANKLIN—*A Means of Seed-dispersal.* —Franklin tells us, in one of his letters, that he saw, in Maryland, a whirlwind which began by taking up the dust which lay in the road, in the form of a sugar-loaf, with the pointed end downwards, and soon after grew to the height of forty or fifty feet, being twenty or thirty in diameter. It advanced in a direction contrary to the wind; and altho the rotary motion of the column was surprisingly rapid, its onward progress was sufficiently slow to allow a man to keep pace with it on foot. Franklin followed it on horseback, accompanied by his son, for three-quarters of a mile, and saw it enter a wood, where it twisted and turned round large trees with surprising force. These were carried up in a spiral line, and were seen flying in the air, together with boughs and innumerable leaves, which, from their height, appeared reduced to the apparent size of flies. As this cause operates at different intervals of time throughout a great portion of the earth's surface, it may be the means of bearing not only plants, but insects, land testacea and their eggs, with many other species of animals, to points which they could never otherwise have reached, and from which they may then begin to propagate themselves again as from a new center.—LYELL *Principles of Geology*, bk. iii, ch. 37, p. 619. (A., 1854.)

3729. WILDERNESS, PLANTING OF THE—*Wind-wafted Seeds—The Tumbleweed.* —There is a very common weed found on waste ground and also in fields and gardens, which on good soil, with plenty of room and light, grows much in the shape of a globe with a diameter of two to three feet. It is called *Amaranthus albus* in the books, and is one of the most prominent of our tumbleweeds. It does not start in the spring from seed till the weather becomes pretty warm. The leaves are small and slender, the flowers very small, with no display, and surrounded by little rigid, sharp-pointed bracts. When ripe in autumn, the dry, incurved branches are quite stiff; the main stem near the ground easily snaps off and leaves the light ball at the mercy of the winds. Such a plant is especially at home on prairies or cleared fields, where there are few large obstructions and where the wind has free access.

The mother plant, now dead, toiled busily during the heat of summer and produced thousands of little seeds. The best portion of her substance went to produce these seeds, giving each a portion of rich food for a start in life, and wrapping each in a glossy black coat. Now she is ready to sacrifice the rest of her body to be tumbled about, broken in pieces, and scattered in every direction for the good of her precious progeny, most of whom will find new places, where they will stand a chance the next summer to grow into plants.—BEAL *Seed Dispersal*, ch. 5, p. 31. (G. & Co., 1898.)

3730. "WILFULNESS," SUPPOSED, IN CHILD—*A Misinterpretation—Perhaps a Lack of Volitional Control.*—Great mistakes are often made by parents and teachers, who . . . treat as wilfulness what is in reality just the contrary of will-fulness, being the direct result of the want of volitional control over the automatic activity of the brain. To punish a child for the want of obedience which it has not the power to render is to inflict an injury which may almost be said to be irreparable. . . . Nothing retards the acquirement of the power of directing the intellectual processes so much as the emotional disturbance which the feeling of injustice provokes. Hence the determination often expressed, to "break the will" of an obstinate child by punishment, is almost certain to strengthen these reactionary influences. Many a child is put into "durance vile" for not learning "the little busy bee," who simply cannot give its small mind to the task, whilst disturbed by stern commands and threats of yet severer punishment for a disobedience it cannot help; when a suggestion kindly and skilfully adapted to its automatic nature, by directing the turbid current of thought and feeling into a smoother channel, and guiding the activity which it does not attempt to oppose, shall bring about the desired result, to the surprise alike of the baffled teacher, the passionate pupil, and the perplexed bystanders.—CARPENTER *Mental Physiology*, ch. 3, p. 135. (A., 1900.)

3731. WILL AS DISTINCT FROM IMPERSONAL FORCE—*Mind Sees in Nature a Reflection of Itself.*—Whatever difficulty there may be in conceiving of a will not exercised by a visible person, it is a difficulty which cannot be evaded by arresting our conceptions at the point at which they have arrived in forming the idea of laws or forces. That idea is itself made up out of elements derived from our own consciousness of personality. This fact is seen by men who do not see the interpretation of it. They denounce as a superstition the idea of any personal will separable from the forces which work in Nature. They say that this idea is a mere projection of our own personality into the world beyond—the shadow of our own form cast upon the ground on which we look. And indeed this, in a sense, is true. It is perfectly true that the mind does recognize in Nature a reflection of itself. But if this be a deception, it is a deception which is not avoided by transferring the idea of personality to the abstract

idea of force, or by investing combinations of force with the attributes of mind.—ARGYLL *Reign of Law*, ch. 2, p. 73. (Burt.)

3732. WILL AS VIEWED BY THE PHYSIOLOGIST — *Volition Connected with Organic Changes—Loss of Power of Will in Mental Derangement.*—As physiologists, we have to deal with volition as a function of the supreme centers, following reflection, varying in quantity and quality as its cause varies, strengthened by education and exercise, enfeebled by disuse, decaying with decay of structure, and always needing for its outward expression the educated agency of the subordinate motor centers. We have to deal with will, not as a single undecomposable faculty unaffected by bodily conditions, but as a result of organic changes in the supreme centers, affected as certainly and seriously by disorder of them as our motor faculties are by disorder of their centers. Loss of power of will is one of the earliest and most characteristic symptoms of mental derangement; and whatever may have been thought in times past, we know well now that the loss is not the work of some unclean spirit that has laid its hands upon the will, but the direct effect of physical disease.—MAUDSLEY *Body and Mind*, lect. 1, p. 28. (A., 1898.)

3733. WILL CREATES NO FORCE—*Existing Bodily Energy Directed by Mind.*—As a physiologist, I most fully recognize the fact that the physical force exerted by the body of man is not generated *de novo* by his will, but is derived from the oxidation of the constituents of his food. But holding it as equally certain, because the fact is capable of verification by every one as often as he chooses to make the experiment, that, in the performance of every volitional movement, that physical force is put in action, directed, and controlled, by the individual personality or "ego," I deem it just as absurd and illogical to affirm that there is no place for a God in Nature, originating, directing, and controlling its forces by his will, as it would be to assert that there is no place in man's body for his conscious mind.—CARPENTER *Nature and Man*, lect. 12, p. 364. (A., 1889.)

3734. WILL, DETHRONEMENT OF, IN INTOXICATION—*Drunkard a Madman—Limits of Responsibility and Punishment.*—When the government of the will is completely overthrown, and the excited passions rage uncontrolled, the drunkard may be most truly said to be a madman, and is, like him, *at the time* completely irresponsible for his actions, since, even if some glimmering consciousness of their criminality should still remain, he has lost all power either of restraining his vehement impulses, or of withdrawing himself from their influence. His responsibility arises from his having knowingly and voluntarily given up the reins of reason and conscience, and subjected himself to the domination of his evil passions; so that his better nature loses its due supremacy, and he becomes the mere instrument of his insane impulses. It has been argued with considerable plausibility that a man ought not to be punished for any crime he may commit in a state of intoxication, since he is then in a state of "temporary insanity"; but that he should be punished as severely for having brought himself into that state. This would doubtless be the most *logical* mode of dealing with the criminal; but as it would require that *every* drunkard should be held guilty of a crime equal in gravity to murder, such punishment could obviously not be enforced.—CARPENTER *Mental Physiology*, ch. 17, p. 651. (A., 1900.)

3735. WILL FIXING ATTENTION ON DIVINE IDEAL—The highest exercise of the will is shown in those who are endowed with vigorous intellectual powers, and whose strong emotional nature gives force to all their tendencies to action, but who determinately fix their attention on the divine ideal, and steadily endeavor to shape their character and direct their conduct in accordance with it.—CARPENTER *Mental Physiology*, bk. i, ch. 9, p. 428. (A., 1900.)

3736. WILL FREE FROM COMPULSION—*Motives Do Not Destroy Freedom.*—It is true that our wills can never be free from motives, and in this sense can never be free from "law." But this is only saying that we can never be free from the relations preestablished between the structure of our minds and the system of things in which they are formed to move. From these, it is true, indeed, that we never can be free. But as a matter of fact, we know that these relations do not involve compulsion. It is from compulsion that our wills are free, and from nothing else; and for this freedom we have the only evidence we can ever have for any ultimate truth respecting the powers of mind—the evidence of consciousness—that is, the evidence of observation turned in upon ourselves.—ARGYLL *Reign of Law*, ch. 6, p. 182. (Burt.)

3737. WILL IN OPPOSITION TO REFLEX ACTION—*Darwin's Experiment—Self-preserving Act Uncontrollable.*—To prevent the reflex action of crying out when in pain, it is often sufficient firmly to clench the teeth or to grasp some object and hold it tight. When the feet are tickled we can, by an effort of will, prevent the reflex action of jerking them up. So, too, the involuntary closing of the eyes and starting, when a blow is aimed at the head, can be similarly restrained.

Darwin has mentioned an interesting example of the way in which, on the other hand, such an instinctive reflex act may override the strongest effort of the will. He placed his face close against the glass of the cobra's cage in the Reptile House at the Zoological Gardens, and tho, of course, thoroughly convinced of his perfect security,

could not by any effort of the will prevent himself from starting back when the snake struck with fury at the glass.—BAKER *Handbook of Physiology*, vol. ii, ch. 18, p. 101. (W. W., 1885.)

3738. WILL IS ULTIMATE—*Not To Be Translated into Simpler Terms.*—The transition from merely considering an object as possible to deciding or willing it to be real; the change from the fluctuating to the stable personal attitude concerning it; from the "don't care" state of mind to that in which "we mean business," is one of the most familiar things in life. We can partly enumerate its conditions; and we can partly trace its consequences, especially the momentous one that when the mental object is a movement of our own body it realizes itself outwardly when the mental change in question has occurred. But the change itself as a subjective phenomenon is something which we can translate into no simpler terms.—JAMES *Psychology*, vol. ii, ch. 26, p. 569. (H. H. & Co., 1899.)

3739. WILL MAY SHUT OUT EVIDENCE—*Refusal to Look through Telescope.*—In the discussion of a question of intellectual truth, the will has the power of keeping some considerations more or less completely out of view, whilst it increases the force of others by fixing the attention upon them. Another familiar proverb, that "there are none so blind as those that won't see," precisely expresses the way in which the will thus exerts its influence. For as the opponents of the Copernican system refused to look at the satellites of Jupiter through the telescope of Galileo, so there are too many who wilfully turn away the eyes of their minds from inconvenient truths, or refuse to get a gleam of sunshine into the dark chambers of their intellects, where they hide as sacred treasures the antiquated beliefs of past ages, the worthlessness of which would be at once apparent if the full light of day were permitted to shine in upon them. —CARPENTER *Nature and Man*, lect. 7, p. 231. (A., 1889.)

3740. WILL, WEAKNESS OF, COUNTERACTED—*Mozart Saved by Good Influence—Help of Father and of Wife Sustained Great Composer.*—Mozart certainly stands alone among musicians, and deserves to rank as a typical example of genius. Mozart, like Coleridge, was a man whose will was weak in proportion to the automatic activity of his mind; and it is probable that if he had not been under the guidance, in the first instance, of a judicious father, and afterwards of an excellent wife, to both of whom he had the good sense to submit himself, his career would have been comparatively inglorious. For his lively sensibility made him the sport of every kind of impulse, so that he could neither keep firm to a resolution, nor resist a temptation; and hence he would never of his own accord have subjected himself to the discipline which his father imposed upon him, and without which he could not have been anything else than a "musical prodigy"; nor would he have had the motive which his conjugal affection supplied, for the steady application that was required for the elaboration of his greatest works. Hence his life becomes a most interesting study to the psychologist, no less than to the musician.—CARPENTER *Mental Physiology*, ch. 6, p. 271. (A., 1900.)

3741. WIND CHANGES CONTOUR OF MOUNTAINS—*Cliffs Shaped by Viewless Air.*—When a strong wind is blowing during a volcanic outburst, the materials may be driven to one side of the vent, and accumulate there more rapidly than on the other. Thus lop-sided cones are formed, such as may frequently be observed in some volcanic districts. In areas where constant currents of air, like the trade-winds, prevail, all the scoria-cones of the district may thus be found to be unequally developed on opposite sides, being lowest on those from which the prevalent winds blow, and highest on the sides towards which these winds blow. —JUDD *Volcanoes*, ch. 4, p. 90. (A., 1899.)

3742. WIND SCATTERS SEEDS—*Samaras or "Keys" of Maple and Ash.*—There are many methods by which seeds have been adapted to dispersal by the wind. The degree of adaptation is greatly varied. With the fruits of many trees the seed-envelopes have been drawn out into thin plates, by means of which in a strong wind—when of course they are most likely to break away from the stem—they may be carried to a considerable distance before falling to the ground. Even then during high winds many of them will be picked up and carried farther.

The familiar fruits, or "keys," of maple and ash at once come to mind as examples of this kind of dispersal. It is to be noted that generally in such cases the seed has a decided advantage in starting at a point some distance from the ground. Its chances of going far afield are much greater than they would be if the seed was borne on a herbaceous plant only a foot or two high. —WEED *Seed Travellers*, pt. i, p. 13. (G. & Co., 1899.)

3743. WINDS OF THE UPPER AIR—*Direction Opposite to That of Surface Currents—Volcanic Ashes Shot into Upper Stream of Air.*—It is not by reasoning alone that we arrive at a knowledge of the existence of the upper atmospheric current, tho reasoning is sufficient to show that compensation must take place somehow—that a wind cannot blow in any direction without an equal displacement of air taking place in the opposite direction. But clouds are sometimes seen in the tropics, high in the atmosphere, moving in a direction opposed to that of the constant wind below. Could we discharge a light body with sufficient force to cause it to penetrate the lower cur-

rent, and reach the higher, the direction of the body's motion would give us that of the wind above. Human strength cannot perform this experiment, but it has nevertheless been made. Ashes have been shot through the lower current by volcanoes, and, from the places where they have subsequently fallen, the direction of the wind which carried them has been inferred. Professor Dove, who has so enriched the knowledge of the age by his researches in meteorology, cites the following instance: "On the night of April 30 explosions like those of heavy artillery were heard at Barbadoes, so that the garrison at Fort St. Anne remained all night under arms. On May 1, at daybreak, the eastern portion of the horizon appeared clear, while the rest of the firmament was covered by a black cloud, which soon extended to the east, quenched the light there, and at length produced a darkness so intense that the windows in the rooms could not be discerned. A shower of ashes descended. Whence came these ashes? From the direction of the wind we should infer that they came from the Azores; they came, however, from the volcano Morne Garou in St. Vincent, which lies about 100 miles west of Barbadoes. The ashes had been cast into the current of the upper trade."—TYNDALL *Heat a Mode of Motion*, lect. 8, p. 209. (A., 1900.)

3744. WINE, ADULTERATION OF—*Connoisseur Demands Impossible Transparency—Use and Effect of Mineral Acids—An Imperial Martyr.*—The wine-merchants are . . . the victims of their customers, who demand an amount of transparency that is simply impossible as a permanent condition of unsophisticated grape wine. To anybody who has any knowledge of the chemistry of wine nothing can be more ludicrous than the antics of the pretending connoisseur of wine who holds his glass up to the light, shuts one eye (even at the stage before double vision commences), and admires the brilliancy of the liquid, this very brilliancy being, in nineteen samples out of twenty, the evidence of adulteration, cookery, or sophistication of some kind. Genuine wine made from pure grape-juice without chemical manipulation is a liquid that is never reliably clear. . . . Partial precipitation, sufficient to produce opalescence, is continually taking place, and therefore the unnatural brilliancy demanded is obtained by substituting the natural and wholesome tartrate by salts of mineral acids, and even by the free mineral acid itself. At one time I deemed this latter adulteration impossible, but have been convinced by direct examination of samples of high-priced (mark this, not cheap) dry sherries that they contained free sulfuric and sulfurous acid. . . .

But what is the effect of such free mineral acid on the drinker of the wine? If he is in any degree predisposed to gout, rheuma-ti[illegible]tone, or any of the lithic-acid diseases, his life is sacrificed, with preceding tortures of the most horrible kind. It has been stated, and probably with truth, that the late Emperor Napoleon III. drank dry sherry, and was a martyr of this kind.—WILLIAMS *Chemistry of Cookery*, ch. 16, p. 274. (A., 1900.)

3745. ———— ———— *Sulfuric Replaces Tartaric Acid—A Clergyman's Costly Error.*—The brilliancy thus obtained [by fining with sulfate of lime] is not lost by age or variations of temperature, and the dry sherries thus cooked are preferred by English wine-drinkers.

The sulfate of potash which, by the action of sulfate of lime, is made to replace bitartrate, is so readily soluble that neither changes of temperature nor increase of alcohol, due to further fermentation, will throw it down; and thus the wine-maker and wine-merchant, without any guilty intent, and ignorant of what he is really doing, sophisticates the wine, alters its essential composition, and adds an impurity in doing what he supposes to be a mere clarification or removal of impurities. . . .

So far, the wine-merchant; but how about the consumer? Simply that the substitution of a mineral acid—the sulfuric for a vegetable acid (the tartaric)—supplies him with a precipitant of lithic acid in his own body; that is, provides him with the source of gout, rheumatism, gravel, stone, etc., with which English wine-drinkers are proverbially tortured.

I am the more urgent in propounding this view of the subject because I see plainly that not only the patients, but too commonly their medical advisers, do not understand it. When I was in the midst of these experiments I called upon a clerical neighbor, and found him in his study with his foot on a pillow, and groaning with gout. A decanter of pale, choice, very dry sherry was on the table. He poured out a glass for me and another for himself. I tasted it, and then perpetrated the unheard-of rudeness of denouncing the wine for which my host had paid so high a price. He knew a little chemistry, and I accordingly went home forthwith, brought back some chlorid of barium, added it to his choice sherry, and showed him a precipitate which made him shudder. He drank no more dry sherry, and has had no serious relapse of gout.—WILLIAMS *Chemistry of Cookery*, ch. 16, p. 278. (A., 1900.)

3746. WINGS OF FLYING-FISH REALLY FINS—*Different Organs with Similar Function.*—When we speak of the flight of birds, of insects, of fishes, of bats, etc., and designate their locomotive organs indiscriminately as wings, it is evident that the character of the motion, and not the special structure of the organs, has determined our nomenclature. We are influenced by the same consideration when we give the name of "fins" to the organs of all animals which

swim in the water, be they whales, turtles, fishes, crustaceans, or mollusks. It requires but a superficial acquaintance with the anatomy of the flying-fishes to perceive that their organs of flight are built upon exactly the same pattern as the pectoral fins of most fishes, and differ entirely from the wing of birds, as also from the wing of bats, the latter being in all essentials a paw, identical with the paw of ordinary quadrupeds, save the length of the fingers and the absence of nails on the longest of them. No wonder, then, that the flight of the flying-fishes should entirely differ from that of birds or bats.—AGASSIZ *Journey in Brazil*, ch. 2, app., p. 522. (H. M. & Co., 1896.)

3747. WISDOM TRANSCENDING HUMAN POWER TO ATTAIN—*Newton's Grand Humility.*—Why . . . should we hesitate to receive the evidence of a philosopher like Newton, who, after spending a long life in the investigation of Nature, and with a success unparalleled in the history of science, uttered this memorable sentiment shortly before his death: "I do not know what I may appear to the world; but to myself I seem to have been only like a boy playing on the seashore, and devoting myself now and then to finding a smoother pebble or a prettier shell than ordinary, while the great ocean of truth lay all undiscovered before me." I know this sentiment has been so many times repeated as to seem trite, but, coming from whom it does, it cannot be too often quoted. It is the testimony of the foremost master of science to its greatest and sublimest truth.

We can all recognize the marks of design in Nature, and when we add to this evidence of our senses the testimony of a man like Newton, who assures us that the more our powers are enlarged, and the wider our knowledge becomes, the grander and vaster the design will appear, until it surpasses all our powers of thought or imagination, we begin to feel the full depth of the truth. . . . If our minds are incapable of comprehending the plan, who could have been equal to the design? "Whence, then, cometh wisdom, and where is the place of understanding, seeing it is hid from the eyes of all living, and kept close from the fowls of the air? . . . God understandeth the way thereof, and he knoweth the place thereof. For he looketh to the ends of the earth, and seeth under the whole heaven, to make the weight for the winds . . . and a way for the lightning of the thunder. Then did he see it and declare it; he prepared it, yea, and searched it out. And unto man he said, Behold the fear of the Lord, that is wisdom, and to depart from evil is understanding" [Job xxviii, 20-28].—COOKE *Religion and Chemistry*, ch. 2, p. 66. (S., 1891.)

3748. WITCH-GRASS ON WINGS OF WIND—*Distribution of Seeds.*—One breezy October morning the neighboring fields presented the appearance of a fairies' carnival. A thousand tenuous will-o'-the-wisps were dancing and sailing and whirling in every direction. Now one alone with feathery grace would glide along, to join a moment later a host of airy sprites, and be wafted hither and thither by the erratic breath of the zephyr god. Here and there the paths of miniature cyclones could be traced by the movements of whirling circles, while in other places solid phalanxes moved steadily forward. The ranks of the revelers were constantly depleted through desertions to the eastward, to be quickly filled by new recruits from out the west.

With some difficulty I caught a few of these feathery sprites, and, holding them securely, started homeward. But a sudden gust of wind left me empty-handed, save for some tiny pieces of stems; the sprites, again at liberty, sailed away with mocking grace. I caught more, and, shielding them from the wind, got them safely indoors, where they proved to be the seed-heads of a grass commonly known as the "old-witch grass."—WEED *Seed Travellers*, pt. i, p. 18. (G. & Co., 1899.)

3749. WOMAN A POWER IN SAVAGE LIFE—*Cowardice Repressed by Fear of Woman's Scorn.*—It must not be supposed that in any state of civilization a man's conduct depends altogether on his own moral sense of right and wrong. Controlling forces of society are at work even among savages, only in more rudimentary ways than among ourselves. Public opinion is already a great power, and the way in which it acts is particularly to be noticed. . . . The assembled tribe can crush the mean and cowardly with their scorn, or give that reward of glory for which the high-spirited will risk goods and life. Travelers have remarked that the women, however downtrodden, know how to make their influence felt in this way, and many a warrior whose heart was failing him in face of the enemy has turned from flight when he thought of the girls' mockery when he should slink home to the village, safe but disgraced.—TYLOR *Anthropology*, ch. 16, p. 408. (A., 1899.)

3750. WOMAN DOMESTICATES THE CAT—*The Guardian of the Food Supply.*—The world has to thank woman for the domestication of the cat. There may be some dispute as to who has the honor of subduing the dog and the milk- and fleece-yielding animals. But woman tamed the wildcat for the protection of her granaries. Of the time when this heartless beast laid down its arms and enlisted in her service no one knoweth. Already at the dawn of written history in Egypt the cat was sacred to Sekhet, or Pasht, daughter of Ra and wife of Ptah. Then as now the cat and the goddess had among their other qualifications the faculty of seeing in the dark. Her method of domestication was to secure the young wildcats and rear them about her household as play-

things for her children, and to gratify them in their instincts of prowling and seizing.—MASON *Woman's Share in Primitive Culture*, ch. 2, p. 18. (A., 1894.)

3751. WOMAN IN GEOLOGY—*Original Discoveries by Lady Gordon Cumming.*—The seat of Sir William Gordon Cumming, of Altyre, is in the neighborhood of one of the Morayshire deposits discovered by Mr. Malcolmson; and for the greater part of the last two years Lady Gordon Cumming has been engaged in making a collection of its peculiar fossils, which already fills an entire apartment. The object of her ladyship was the illustration of the geology of the district, and all she sought in it on her own behalf was congenial employment for a singularly elegant and comprehensive mind. But her labors have rendered her a benefactor to science. Her collection was visited, shortly after the late meeting of the British Association in Glasgow, by Agassiz and Dr. Buckland; and great was the surprise and delight of the philosophers to find that the whole was new to geology. All the species, amounting to eleven, and at least one of the genera, that of the *Glyptolepis*, were different from any Agassiz had ever seen or described before.—MILLER *The Old Red Sandstone*, ch. 7, p. 123. (G. & L., 1851.)

3752. WOMAN, PARENTAL LOVE STRONGEST IN—*Mother's Devotion to Her Child.*—Parental love is an instinct stronger in woman than in man, at least in the early childhood of its object. I need do little more than quote Schneider's lively description of it as it exists in her:

"As soon as a wife becomes a mother her whole thought and feeling, her whole being, is altered. Until then she had only thought of her own well-being, of the satisfaction of her vanity; the whole world appeared made only for her; everything that went on about her was only noticed so far as it had personal reference to herself; she asked of every one that he should appear interested in her, pay her the requisite attention, and as far as possible fulfil her wishes. Now, however, the center of the world is no longer herself, but her child. She does not think of her own hunger, she must first be sure that the child is fed. It is nothing to her that she herself is tired and needs rest, so long as she sees that the child's sleep is disturbed; the moment it stirs she awakes, tho far stronger noises fail to arouse her now. . . . But not only the contact, the bare look of the offspring affords endless delight, not only because the mother thinks that the child will some day grow great and handsome and bring her many joys, but because she has received from Nature an instinctive love for her children. She does not herself know why she is so happy, and why the look of the child and the care of it are so agreeable, any more than the young man can give an account of why he loves a maiden, and is so happy when she is near. Few mothers, in caring for their child, think of the proper purpose of maternal love for the preservation of the species. Such a thought may arise in the father's mind; seldom in that of the mother. The latter feels only . . . that it is an everlasting delight to hold the being which she has brought forth protectingly in her arms, to dress it, to wash it, to rock it to sleep, or to still its hunger."—JAMES *Psychology*, vol. ii, ch. 24, p. 440. (H. H. & Co., 1899.)

3753. WOMAN, THE MYSTERIOUS BIFOLD LIFE OF—"The Germans believe that there is something sacred and prophetic in woman; therefore they respect the counsel of women and hearken to their judgments" (Tacitus). In fact, both of those preeminent antique nations (Greece and Rome) never regarded woman as more than a thing, always as only the servant, in no respect the partner of man, his equal in birth; while the Germans regarded woman, weak physically, as nevertheless a creature of fine intellectual development, having, therefore, a right to protection and forbearance, to reverence and sacred consideration. The emotional side of humanity was regarded her strength, that invisible, mysterious power closely related to the divine, before which one retires with a natural awe, as from something supernatural. And yet just as throughout Nature we have day and night, summer and winter, so throughout the life of the Germanic woman there runs that bipartition which on the one hand permits her to appear like unto the gods, and on the other represents her in slavish inferiority. Her legal position was entirely subordinate.—REINSCH *Stellung und Leben der deutschen Frau im Mittelalter (Virchow und Holtzendorff's Sammlung wissenschaftlicher Vorträge, 1882).* (Translated for *Scientific Side-Lights.)*

3754. WOMAN THE SUPPORT OF RELIGION — Was it accident, or a prophetic token, that Greek architecture employed superb female figures called caryatides, in the place of pillars, as supports for the halls of their temples?—HOLTZENDORFF *Frauenrechte (a Lecture).* (Translated for *Scientific Side-Lights.)*

3755. WOMAN'S CULTURE, ERRORS AFFECTING—*Highest Development of Character Required.*—Fathers and mothers are still mostly of opinion that light caliber in their daughters would find most approval from their prospective husbands. They believe that the master of the house should train his wife to suit his own taste and requirements, and think that a character of wax forms the most suitable raw material. They erroneously assume that a dependent, unenlightened creature, without any aim, is equal to the capacity for sacrifice and personal devotion. From traditions in the family, young girls acquire the notion that marriage signifies chiefly promotion in social rank,

release from parental authority doing away with manifold limitations founded on custom. All of the deeper moral relations, the most difficult duties, and the problems of self-abnegation are hidden from youth, and cannot be made comprehensible to them. But the likelihood of the fulfilment of duty does not increase with the systematic fostering of ignorance, or the fear of overculture, but with that moral effort that will not allow any year to pass without profit, with the development of ripe understanding and a firm, self-conscious will.—HOLTZENDORFF *Die Verbesserungen in der gesellschaftlichen und wirthschaftlichen Stellung der Frauen (a Lecture)*. (Translated for *Scientific Side-Lights.)*

3756. WOMAN'S MISSION—*The Struggle for the Life of Others—Motherhood—Psychical Attributes of Sex.*—That cleavage, therefore, which began in the merely physical region is now seen to extend into the psychical realm, and ends by supplying the world with two great and forever separate types. No efforts, or explanations, or expostulations can ever break down that distinction between maleness and femaleness, or make it possible to believe that they were not destined from the first of time to play a different part in human history. Male and female never have been and never will be the same. They are different in origin; they have traveled to their destinations by different routes; they have had different ends in view. The result is that they are different, and the contribution, therefore, of each to the evolution of the human race is special and unique. . . . To him [man] has been mainly assigned the fulfilment of the first great function—the struggle for life. Woman . . . is the chosen instrument for carrying on the struggle for the life of others. Man's life, on the whole, is determined chiefly by the function of nutrition; woman's by the function of reproduction. Man satisfies the one by going out into the world, and in the rivalries of war and the ardors of the chase, in conflict with Nature, and amid the stress of industrial pursuits, fulfilling the law of self-preservation; woman completes her destiny by occupying herself with the industries and sanctities of the home, and paying the debt of motherhood to her race.—DRUMMOND *Ascent of Man*, ch. 7, p. 256. (J. P., 1900.)

3757. WOMEN THE INVENTORS OF TEXTILES AND POTTERY—*Mental Power Required for Early Inventions.*—Only now and then the angry sky was lighted for the primitive man by electricity, and even then it filled him with terror. But it was he that invented the apparatus for conjuring from dried wood, by a rude sort of dynamo, the Promethean spark. It was our Aryan ancestors that paid their devotions to the rising sun by kindling fresh fire every morning as the orb of day flashed his first beam across the earth.

Who has not read with almost breaking heart the story of Palissy, the Huguenot potter? But what have our witnesses to say of that long line of humble creatures that conjured out of prophetic clay, without wheel or furnace, forms and decorations of imperishable beauty, which are now being copied in glorified material in the best factories of the world? In ceramic as well as in textile art the first inventors were women. They quarried the clay, manipulated it, constructed and decorated the ware, burned it in a rude furnace, and wore it out in a hundred uses.—MASON *The Birth of Invention (Address at Centenary of American Patent System, Washington, D. C., 1891; Proceedings of the Congress*, p. 409).

3758. WONDERS OF LIFE REVEALED BY CLOSER STUDY—*Phosphorescence of Ocean Due to Light-bearing Animals.*—The luminosity of sea-water is in part owing to living light-bearing animals, and in part to the organic fibers and membranes of the same, when in a state of decomposition. The first named of these causes of the phosphorescence of the ocean is undoubtedly the most common and the most widely diffused. The more actively and the more efficiently that travelers engaged in the study of Nature have learned to employ powerful microscopes, the more our zoological systems have been enriched by new groups of *Mollusca* and *Infusoria*, whose property of emitting light either at will or from external stimulus has been recognized. . . . The development of light [is] an organic vital process, which exhibits itself in infusorial animals as a momentary spark of light, and is repeated after short intervals of rest.—HUMBOLDT *Views of Nature*, p. 247. (Bell, 1896.)

3759. WONDERS OF NATURE—*Glacier-tables in the Alps.*—A mass of rock, having fallen on the surface of the glacier, protects the ice immediately beneath it from the action of the sun; and as the level of the glacier sinks all around it, in consequence of the unceasing waste of the surface, the rock is gradually left standing on an ice-pillar of considerable height. In proportion as the column rises, however, the rays of the sun reach its sides, striking obliquely upon them under the boulder, and wearing them away, until the column becomes at last too slight to sustain its burden, and the rock falls again upon the glacier; or, owing to the unequal action of the sun, striking, of course, with most power on the southern side, the top of the pillar becomes slanting, and the boulder slides off. These ice-pillars, crowned with masses of rock, form a very picturesque feature in the scenery of the glacier, and are represented in many of the landscapes in which Swiss artists have endeavored to reproduce the grandeur and variety of Alpine views, especially in the masterly aquarelles of Lory. The English reader will find them admirably

well described and illustrated in Dr. Tyndall's work upon the glaciers. They are known throughout the Alps as "glacier-tables."—AGASSIZ *Geological Sketches*, ser. i, ch. 8, p. 285. (H. M. & Co., 1896.)

3760. ——— ——— *Milk from Tropical Tree—The Cow-tree.*—We had already heard a good deal about this tree [the *Massaranduba*, or cow-tree], and about its producing from its bark a copious supply of milk as pleasant to drink as that of the cow. We had also eaten its fruit in Para, where it is sold in the streets by negro market-women, and had heard a good deal of the durableness in water of its timber. We were glad, therefore, to see this wonderful tree growing in its native wilds. It is one of the largest of the forest monarchs, and is peculiar in appearance on account of its deeply scored, reddish, and ragged bark. A decoction of the bark, I was told, is used as a red dye for cloth. A few days afterward we tasted its milk, which was drawn from dry logs that had been standing many days in the hot sun at the sawmills. It was pleasant with coffee, but had a slight rankness when drank pure; it soon thickens to a glue, which is excessively tenacious, and is often used to cement broken crockery. I was told that it was not safe to drink much of it, for a slave had recently nearly lost his life through taking it too freely.—BATES *Naturalist on the River Amazon*, ch. 2, p. 635. (Hum., 1880.)

3761. WONDERS OF SUPERSTITION SURPASSED BY THE WONDERS OF SCIENCE—*Distances from which Comets Come—Millions of Years on Their Way—Witnesses of Vanished Eras—Ancient Testimony of the Existence of Matter.*—Do we ever think what an immense voyage they [comets] must have made to come from there to here? Do we imagine for how many years they must have flown through the dark immensity to plunge themselves into the fires of our sun? If we take into account the directions from which certain comets come to us, and if we assign to the stars situated in that region the least distances consistent with known facts, we find that these comets certainly left their last star more than 20,000,000 years ago.

In thus putting to us from the height of their celestial apparitions so many notes of interrogation on the grandest problems of creation, comets assume to our eyes an interest incomparably greater than that with which superstition blindly surrounded them in past ages. When we reflect for a moment that a certain comet which shines before us in the sky came originally from the depths of the heavens, that it has traveled during millions of years to arrive here, and that, consequently, it is by millions of years that we must reckon its age if we wish to form any idea of it, we cannot refrain from respecting this strange visitor as a witness of vanished eras, as an echo of the past, as the most ancient testimony which we have of the existence of matter. But what do we say? These bodies are neither old nor young; there is nothing old, nothing new; all is present: the ages of the past contemplate the ages of the future, which all work, all gravitate, all circulate in the eternal plan. Musing, you look at the river which flows so gently at your feet, and you believe you see again the river of your childhood; but the water of to-day is not that of yesterday; it is not the same substance which you have before your eyes, and never, never shall this union of molecules, which you behold at this moment, come back there, never till the consummation of the ages!—FLAMMARION *Popular Astronomy*, bk. v, ch. 3, p. 528. (A.)

3762. WONDERS, SCIENCE DOES NOT MAKE LESS—*An Explanation Is a Statement of a Grander Fact—Gravitation a Marvelous Truth.*—People are apt to think that when the scientific explanation of a fact is given, the fact in question ceases to be wonderful. But if we would but reflect, we should see that this explanation is only another fact of a more general kind, and one which ought, therefore, to be regarded as more striking, one which ought to incite us to more curious inquiry. That a stone, dropped in the air, falls to the ground, is so familiar an experience that it could excite wonder only in the most reflective minds. But when it did excite wonder and curiosity, the fact was made not less, but much more wonderful when its scientific explanation was furnished in Newton's law of gravitation—a law according to which we find that a stone is, as it were, drawn to the earth by a force which can be measured, and by which the earth acts on the moon precisely in the same way as it does upon a stone dropped in the air. That explanation is a very wonderful fact, one that leads men of science to inquire why this should be so, tho it requires a scientific training to appreciate that kind of curiosity. —CHISHOLM *Nature-Studies*, p. 26. (Hum., 1888.)

3763. WORD ASSOCIATED WITH ITS MEANING—*Empty Repetition Gives Feeling of Unnaturalness.*—This [difference between perception of particulars and of a whole which includes them] is probably the reason why, if we look at an isolated printed word and repeat it long enough, it ends by assuming an entirely unnatural aspect. Let the reader try this with any word on this page. He will soon begin to wonder if it can possibly be the word he has been using all his life with that meaning. It stares at him from the paper like a glass eye, with no speculation in it. Its body is indeed there, but its soul is fled. It is reduced, by this new way of attending to it, to its sensational nudity. We never before attended to it in this way, but habitually got it clad with its meaning the moment

we caught sight of it, and rapidly passed from it to the other words of the phrase. We apprehended it, in short, with a cloud of associates, and, thus perceiving it, we felt it quite otherwise than as we feel it now divested and alone.—JAMES *Psychology*, vol. ii, ch. 19, p. 80. (H. H. & Co., 1899.)

3764. WORDS, THEIR UNDYING POWER—In all . . . later studies, verbal material is the vehicle by which the mind thinks. The abstract conceptions of physics and sociology may, it is true, be embodied in visual or other images of phenomena, but they need not be so; and the truth remains that, after adolescence has begun, "words, words, words" must constitute a large part, and an always larger part as life advances, of what the human being has to learn. This is so even in the natural sciences, so far as these are causal and rational, and not merely confined to description.—JAMES *Talks to Teachers*, ch. 12, p. 149. (H. H. & Co., 1900.)

3765. WORK, ANCIENT AND MODERN, COMPARED—*How Machinery Would Rebuild the Great Pyramid.*—I know we are frequently referred to the immense masses of stone transported and wrought by ancient art, which are found among the ruins of Baalbec and Thebes, and are frequently told that the management of these would far transcend the skill and power of modern engineers. Such assertions are, however, rather intended to convey an idea of the impression produced upon the beholder of these venerable ruins than a declaration of absolute truth. As a sufficient illustration of this we may mention the fact that in New York large buildings of brick and stone are moved from place to place while the inhabitants remain undisturbed within; or we may point to the Menai Strait tubular bridge, a structure of cast-iron several hundred tons in weight, suspended in mid air over a chasm more than a hundred feet deep.

The pyramid of Cheops is said to have employed the power of 100,000 men for twenty years in its erection; but, vast as is this pile, were the steam-engines employed in one of our large cities directed to the task of rearing one of equal magnitude the whole would be accomplished in a few weeks.—HENRY *Improvement of the Mechanical Arts (Scientific Writings*, vol. i, p. 321). (Sm. Inst., 1886.)

3766. WORK A SPECIFIC—*Rest Joyful Because of Previous Toil.*—Sooner or later every intellectual canker disappears before earnest work, the influence of which, moreover, fills a wide margin beyond the time of its actual performance. Thus, to-day, I sang as I rolled along—not with boisterous glee, but with serene and deep-lying gladness of heart. This happiness, however, had its roots in the past, and, had I not been a worker previous to my release from London, I could not now have been so glad an idler. In any other country than Switzerland the valley through which we sped would have called forth admiration and delight. Noble fells, proudly grouped, flanked us right and left. Cloudlike woods of pines overspread them in broad patches, with between them spaces of the tenderest green, while among the meadows at their feet gleamed the rushing Rhine.—TYNDALL *Hours of Exercise in the Alps*, ch. 5, p. 62. (A., 1898.)

3767. WORK, INCESSANT, OF INSECTS—*Industry of Ants—Long Days of Labor—Persevering Toil.*—In industry ants are not surpassed even by bees and wasps. They work all day, and in warm weather, if need be, even at night, too. I once watched an ant from six in the morning, and she worked without intermission till a quarter to ten at night. I had put her to a saucer containing larvæ, and in this time she carried off no less than a hundred and eighty-seven to the nest. I had another ant, which I employed in my experiments, under continuous observation several days. When I started for London in the morning, and again when I went to bed at night, I used to put her in a small bottle, but the moment she was let out she began to work again. On one occasion I was away from home for a week. On my return I took her out of the bottle, placing her on a little heap of larvæ about three feet from the nest. Under these circumstances I certainly did not expect her to return. However, tho she had thus been six days in confinement, the brave little creature immediately picked up a larva, carried it off to the nest, and after half an hour's rest returned for another.—AVEBURY *Ants, Bees, and Wasps*, ch. 1, p. 27. (A., 1900.)

3768. WORK INVOLVES THE UNDOING OF SOME PREVIOUS WORK—*Clock—Mill-wheel—Rifle.*—Whenever work is done, it is by the undoing of some previous work. When a clock moves, it is the unwinding of a spring or the falling of a weight which keeps it going, and some one must have wound it up to begin with. If the water of a river falls year after year over a cataract, and is intercepted to drive our mill-wheels, the river continues to run because some power [that of the sun] is continually raising and returning to the hilltops the water which has flowed into the sea—a process precisely equivalent to the daily rewinding of the clock. If the powder in a rifle explodes and drives out the bullet, its explosive energy depends upon the fact that some power has placed the component molecules in such relations that, when the trigger is pulled, and the exciting spark has, so to speak, cut the bonds which hold them apart, they rush together just as suspended weights would fall if freed. Before the same substance, which once was a charge of gunpowder, but now is dust and gas, can again do the same work, the prod-

ucts of the explosion must by some power be decomposed, and the atoms replaced in the same relations as before the firing of the gun; and this process is mechanically analogous to the lifting of fallen weights and placing them upon elevated shelves, or hanging them from hooks, ready to drop again when the occasion may require.—YOUNG *The Sun*, int., p. 3. (A., 1898.)

3769. WORK OF MAN AND WOMAN AMONG ABORIGINES—*Carving for Man—Basketry and Pottery for Woman—White Man's Tools Not an Improvement.*—There ought to be no doubt that in every case where the savage was fortunate enough to obtain the knife his carving and whittling were better done. There is a marvelous difference between carving, on the one hand, man's work chiefly, and basketry or pottery, on the other, conservative woman's work. In no tribes were the two last-named arts bettered by contact with the higher race. The work was done with the hands almost wholly. The tools were of the simplest character. The harsh iron awl was not so good as the smooth-pointed bone awl, of which hundreds have been found, and the pride in personal endeavor departed with the quenching of the tribal spirit. The potter's wheel, such as it was three centuries ago, was only a barrier to the unmechanical sex. Therefore those who constantly assert that prejudice made it impossible for the savage to better himself in the adoption of the white man's devices catch only half a truth. —MASON *The Man's Knife among the North American Indians (Report of U. S. National Museum for 1897*, p. 727).

3770. WORK OF WOMAN THE CALENDAR OF PRIMITIVE MAN—The work of the men among the Omahas, according to Dorsey, was regulated essentially by that of the women, who were to them a sort of calendar. The summer hunt was undertaken after the women had planted the corn and the pumpkins, and the beans had been gathered. They returned on the ripening of the sunflower. They went on the fall hunt when the hair on the game was thick and warm, out of which the women made the clothing. The women buried in caches whatever they wished to leave. Food, etc., was placed in a blanket, which was gathered at the corners and tied with a thong; then the bundle was allowed to fall at the bottom of the cache. Then the women went over the corn fields to see that all the work had been finished. They prepared pack-saddles and litters and mended moccasins and other clothing. The day for the departure having arrived, the women loaded their horses and dogs and took as great weights on their own backs as they could conveniently transport. —MASON *Woman's Share in Primitive Culture*, int., p. 9. (A., 1894.)

3771. WORK UNFINISHED—*Tools of Ancient Miners Found as Left in Distant Age.*—In one case the roof of a passage had given way. On removing the chalk which had fallen in, the end of the gallery came in view. The flint had been hollowed out in three places, and in front of two of these recesses, pointing towards the half-excavated stone, were two deer-horn picks, lying just as they had been left, still coated with chalk dust, on which was in one place plainly visible the print of the workman's hand. The tools had evidently been left at the close of a day's work; during the night the gallery had fallen in, and they had never been recovered.

"It was a most impressive sight," says Mr. Greenwell, "and one never to be forgotten, to look, after a lapse, it may be, of 3,000 years, upon a piece of work unfinished, with the tools of the workmen still lying where they had been placed so many centuries ago."—AVEBURY *Prehistoric Times*, ch. 4, p. 79. (A., 1900.)

3772. WORK WROUGHT BY THE SUN ON EARTH—*Calculation in Horse-power.*—The sun is the mighty source from which proceed all the forces which set in motion the earth and its life. It is its heat which causes the wind to blow, the clouds to ascend, the river to flow, the forest to grow, the fruit to ripen, and man himself to live. The force constantly and silently expended in raising the reservoirs of rain to their mean atmospheric height, in fixing the carbon in the plants, in giving to terrestrial Nature its vigor and its beauty, has been calculated from a mechanical point of view; it is equal to the work of 217,316,000,000,000 horse-power; 543 milliards (543,000,000,000) of steam-engines, each with an effective power of 400 horses, would have to work day and night without intermission: such is the permanent work of the sun upon the earth.—FLAMMARION *Popular Astronomy*, bk. iii, ch. 3, p. 245. (A.)

3773. WORKER, INSIGNIFICANT, ACHIEVES VAST RESULTS—*Progress against Resistance—Coral Islands.*—Every one must be struck with astonishment when he first beholds one of these vast rings of coral rock [the atolls], often many leagues in diameter, here and there surmounted by a low, verdant island, with dazzling white shores, bathed on the outside by the foaming breakers of the ocean, and on the inside surrounding a calm expanse of water, which, from reflection, is generally of a bright but pale green color. The naturalist will feel this astonishment more deeply after having examined the soft and almost gelatinous bodies of these apparently insignificant coral polypifers, and when he knows that the solid reef increases only on the outer edge, which day and night is lashed by the breakers of an ocean never at rest.—DARWIN *Coral Reefs*, int., p. 1. (A., 1898.)

3774. WORLD, A DIVIDED—*Barrier which the Inorganic Cannot Cross—Biogenesis.*—What essentially is involved in saying

that there is no spontaneous generation of life? It is meant that the passage from the mineral world to the plant or animal world is hermetically sealed on the mineral side. This inorganic world is staked off from the living world by barriers which have never yet been crossed from within. . . . Only by the bending down into this dead world of some living form can these dead atoms be gifted with the properties of vitality; without this preliminary contact with life they remain fixed in the inorganic sphere forever. It is a very mysterious law which guards in this way the portals of the living world. And if there is one thing in Nature more worth pondering for its strangeness it is the spectacle of this vast, helpless world of the dead cut off from the living by the law of biogenesis and denied forever the possibility of resurrection within itself. So very strange a thing, indeed, is this broad line in Nature that science has long and urgently sought to obliterate it. Biogenesis stands in the way of some forms of evolution with such stern persistency that the assaults upon this law for number and thoroughness have been unparalleled. But, as we have seen, it has stood the test. Nature, to the modern eye, stands broken in two. "The present state of knowledge furnishes us with no link between the living and the not-living." (Huxley, "Encyclopædia Britannica," new ed., art. "Biology.")—DRUMMOND *Natural Law in the Spiritual World*, essay 1, p. 61. (H. Al.)

3775. WORLD LIGHTED BY A BLUE AND AN ORANGE SUN—*Its Strange Varieties of Day and Night.*—In the first place, let us take the case where the world is between the orange sun and the blue one, and let us suppose that the season corresponds to our spring. Then it is manifest that since one sun illumines one side of the globe, and the other illumines the other, there can be no night; it is orange day to one half of the world, and blue day to the other. Moreover, since the season corresponds to our springtime, it follows that orange day lasts exactly as long as blue day, and using for convenience the division of the day into twenty-four hours (which may or may not be nearly the same as our terrestrial hours), there are, all over the world, twelve hours of orange day and twelve hours of blue day. This, however, would not last very long, any more than on our own earth we have Jupiter visible all night for any length of time. The blue sun would gradually take up the position which Jupiter has when he is an evening star. . . . The blue sun would, in fact, rise before the orange sun had set. Thus there would be orange day as before, but towards orange sunset there would be two suns, the orange sun nearing the west, the blue sun passing over the eastern horizon. Then would come orange sunset and blue day; but the blue sun would set before the orange sun rose, and there would be, therefore, a short night, tho, no doubt, not a dark night, since there would be blue twilight in the west and orange twilight in the east. Gradually the length of this night would increase, the length of the double day also increasing, but the orange and blue hours gradually shortening. At length the blue sun would have drawn quite near to the place of the orange sun in the heavens, and there would be double day and night, but neither orange day nor blue day alone. The double day would probably be white, since the colors of the two suns are supposed to be complementary. After this the blue sun would pass to the other side (the west) of the orange sun, and would be placed like Jupiter when he is a morning sun. There would then be blue morning, white day, orange evening, and night, the night gradually growing shorter and shorter, until at length the blue sun would be opposite the orange sun, and there would be no night, but simple alternation of blue day and orange day, as at first.—PROCTOR *Expanse of Heaven*, p. 229. (L. G. & Co., 1897.)

3776. WORLD THE PRODUCT OF WARRING SYSTEMS—*Doctrines of Gnostics and Manichæans.*—Some Gnostics went so far as to hold that the world was originally created by the devil, and is to be gradually purified and redeemed by the beneficent power of God as manifested through Jesus Christ. This notion is just the opposite to that of the Vendidad, which represents the world as coming into existence pure and perfect, only to be forthwith defiled by the trail of the serpent Ahriman. In both these opposing theories the divine power is distinctly and avowedly curtailed by the introduction of a rival power that is diabolical; upon this point Parsee and Gnostic are agreed. Distinct sources are postulated for the evil and the good. The one may be regarded as infinite in goodness, the other as infinite in badness, and the world in which we live is [held to be] a product of the everlasting conflict between the two.—FISKE *Through Nature to God*, pt. i, ch. 3, p. 14. (H. M. & Co., 1900.)

3777. WORLD, UNSEEN, OF FUNDAMENTAL IMPORTANCE—*The Consummation of Evolution There.*—So far as our knowledge of Nature goes, the whole momentum of it carries us onward to the conclusion that the unseen world, as the objective term in a relation of fundamental importance that has coexisted with the whole career of mankind, has a real existence; and it is but following out the analogy to regard that unseen world as the theater where the ethical process is destined to reach its full consummation.—FISKE *Through Nature to God*, pt. iii, ch. 10, p. 190. (H. M. & Co., 1900.)

3778. WORLD WITHOUT AN ATMOSPHERE—*Effects of Rarefied Air—Opposites Unite—The Sun's Rays Burn amid Wintry Cold.*—[The investigator cannot go to the moon]; but he may go if he pleases, as I have done, to the waterless, shadeless waste which stretches at the eastern slope of the Sierra Nevadas. . . . The sky is cloudless, and the air so clear that all idea of the real distance and size of things is lost. The mountains, which rise in tremendous precipices above him, seem like moss-covered rocks close at hand, on the tops of which, here and there, a white cloth has been dropped; but the "moss" is great, primeval forests, and the white cloths large isolated snow-fields, tantalizing the dweller in the burning desert with their delusive nearness. When I climbed the mountains, at an altitude of ten thousand feet I already found the coolness delicious, but at the same time (by the strange effect I have been speaking of) the skin began to burn, as tho the seasoning in the desert counted for nothing at all; and as the air grew thinner and thinner while I mounted still higher and higher, tho the thermometer fell, every part of the person exposed to the solar rays presented the appearance of a recent severe burn from an actual fire—and a really severe burn it was, as I can testify—and yet all the while around us, under this burning sun and cloudless sky, reigned a perpetual winter which made it hard to believe that torrid summer still lay below. The thinner the air, then, the colder it grows, even where we are exposed to the sun, and the lower becomes the reading of the thermometer. Now, by means of suitable apparatus, it was sought by the writer to determine, while at this elevation of fifteen thousand feet, how great the fall of temperature would be if the thin air there could be removed altogether; and the result was that the thermometer would under such circumstances fall, at any rate, below zero in the full sunshine.—LANGLEY *New Astronomy*, ch. 5, p. 160. (H. M. & Co., 1896.)

3779. WORLDS ALWAYS IN THE LIGHT—*Every Star a Sun—"There Shall Be No Night There" (Rev. xxi, 25; xxii, 5).*—We can . . . form some idea of the wonderful scene presented to the inhabitants of such a world [circling round one sun of a star-cluster], because in reality it is no other than that, which would be presented to ourselves if all the stars seen on the darkest and clearest night were to grow suddenly in luster until the faintest shone with light enough alone to banish night. The wonderful scene thus presented must be carried round by a stately motion of rotation precisely as happens with our own star sphere. Suns must be always rising and always setting, only the magnificent colors which adorn our skies at sunrise and sunset must be wanting there, banished by the excess of splendor. It is manifest that, at least when the sky is clear, there can be no shadows in the landscapes on those distant worlds, since every quarter of the sky must have its suns. When the sky is partially clouded there will be shadows, tho not well-defined shadows such as we recognize, but rather the lightest possible shade on those sides of objects which lie towards the clouded portion of the sky. —PROCTOR *Expanse of Heaven*, p. 217. (L. G. & Co., 1897.)

3780. ——— ——— *Night Unknown to Dwellers amid Star-clusters.*—I have spoken thus far of but two stars out of the thousands on thousands composing the star-cluster. All these thousands would shine with a brightness enormously exceeding that of any of the stars we see, and many hundreds among them would appear as suns, smaller than the two nearest suns before considered, but bright enough with their sole luster to banish night.

It follows, then, that to a globe placed as we have supposed, and traveling around one or other of the suns composing the cluster, night would be absolutely unknown. There would be different degrees of daylight, from the broadest day on the part of the globe turned fully towards the nearest sun, to a less brilliant day on the opposite part turned to other suns, but always day, often very much brighter than our summer noon, and seldom fainter, since the number of suns would make up for the comparative smallness of each.—PROCTOR *Expanse of Heaven*, p. 209. (L. G. & Co., 1897.)

3781. WORLDS, OTHER, MAY BE INHABITED—*Conditions of Life on Mars—Supposed Inhabitants.*—Such is the general physiology of this neighboring planet [Mars]. The atmosphere which surrounds it, the waters which irrigate and fertilize it, the rays of the sun which warm and illuminate it, the winds which pass over it from one pole to the other, the seasons which transform it, are so many elements from which to construct for it an order of life analogous to that which has been conferred on our planet. The weakness of gravity at its surface must materially modify this order of life in adapting it to its special condition. Henceforth the globe of Mars should no longer be presented to us as a block of stone revolving in the midst of the void, in the sling of the solar attraction, like an inert, sterile, and inanimate mass; but we should see in it a living world, adorned with landscapes similar to those which charm us in terrestrial Nature; a new world which no Columbus will ever reach, but on which, doubtless, a human race now resides, works, thinks, and meditates as we do on the great and mysterious problems of Nature. These unknown brothers are not spirits without bodies, or bodies without spirits, beings supernatural or extranatural, but active beings, thinking, reasoning as we do here.

They live in society, are grouped in families, associated in nations, have raised cities, and conquered the arts. Doubtless, their senses of sight and hearing do not differ essentially from ours, and if we happened to pass a day not far from their abodes, we should perhaps be surprised with their architecture, or charmed by the echo of melodious harmony, reminding us of the musical inspirations of our great masters. In the midst of varieties inherent to planetary diversities and the secular metamorphoses of worlds, we should find the same vital torch kindled on all the spheres.—FLAMMARION *Popular Astronomy*, bk. iv, ch. 4, p. 397. (A.)

3782. ——— ——— *Experience Not the Measure of Possibility—Increase of Knowledge Leads to Modesty of Judgment—Life in Ocean Depths.*—We are apt to forget that the forms of life we are accustomed to are not necessarily the only possible forms of life. It is almost impossible to say under what conditions life is possible or impossible. Men of science have lately been taught this in a very striking manner. For, judging by what they know of the state of things at the bottom of the deep sea, they concluded that there could be no living creatures there. They reasoned that the pressure exerted by the water would crush the life out of any known creature, which was unquestionably true. . . . The tremendous mail of the crocodile or the thick skin of the rhinoceros would be unable to resist a tithe of the enormous pressure exerted by the water at the bottom of deep seas. Yet it is now known that creatures not only exist down there, but that, notwithstanding the great darkness which must prevail there, these creatures are provided with the means of seeing. So unlike are they to all other creatures, however, that they are unable to live out of their native depths, and when dragged up by the dredges they burst asunder and are killed long before reaching the surface. This should teach us that altho it may be proved that in some inaccessible world, like Venus or any of her fellow planets, the conditions which prevail are not such as would be convenient to terrestrial creatures, or are even such that no creatures known to us could endure them even for a few minutes, life may nevertheless exist.—PROCTOR *Expanse of Heaven*, p. 49. (L. G. & Co., 1897.)

3783. ——— ——— *Neptune—Life in Ocean Depths—Supposed Impossibility Overcome.*—Is this equivalent to saying that this world [Neptune] is condemned to remain eternally in the state of a sterile and uninhabited desert? Nature herself replies that such a supposition would be entirely contrary to her acts and her views. Short-sighted naturalists, who think they know everything, would teach dogmatically that a pressure of so many atmospheres prevents life from being produced; that a certain amount of light is indispensable to life, and that the ocean depths are absolutely destitute of all vital manifestation. A ship starts on an immense liquid plain to visit the equatorial and polar zones, casts the sounding-line at 2,000 fathoms, at 10,000 feet in depth, in eternal night—a black darkness, where the pressure is such that could a man descend there he would have to support a weight equal to that of twenty locomotives, each accompanied by a train of wagons loaded with bars of iron. Evidently there is nothing there! The sounding-line is drawn in, however, and brings up charming, delicate beings which the lightest touch of the finger of Psyche would kill: they live there tranquil, happy, "like the fish in water," and, since there is no light there, they make it! If they could understand you, you should not speak to them of your castles, your parks and venerable trees, nor of the Paris worldling and the boulevards which you love so much; they prefer their abode, their dark abode in the depths of the sea, scarcely illuminated with the light of their own phosphorescence, and to them there is the true medium, there is real happiness. And when you cast these living débris on the deck of the ship, and when these marvelous beings with variegated embroideries die before your eyes, overwhelmed by the light of the sky, suffocated by the rarefaction of the air which nourishes your lungs, do you not think of Neptune? Do you not see that the god of the ocean has down there an empire as vast as the one we see? And as they have there 900 times less light and heat than on the deck of your ship, you imagine that Nature has been unable to produce anything there! Error, foolish, insane error, excusable, perhaps, in the time of Aristotle, but absolutely unpardonable now.—FLAMMARION *Popular Astronomy*, bk. iv, ch. 9, p. 469. (A.)

3784. WORMS AS BUILDERS—*Intelligent Skill Shown in the Lining of Their Burrows.*—Many leaves of the Scotch fir or pine *(Pinus sylvestris)* were given to worms kept in confinement in two pots; and when after several weeks the earth was carefully broken up, the upper parts of three oblique burrows were found surrounded for lengths of 7, 4, and 3½ inches with pine leaves, together with fragments of other leaves which had been given the worms as food. Glass beads and bits of tile, which had been strewed on the surface of the soil, were stuck into the interstices between the pine leaves; and these interstices were likewise plastered with the viscid castings voided by the worms. The structures thus formed cohered so well that I succeeded in removing one with only a little earth adhering to it. It consisted of a slightly curved cylindrical case, the interior of which could be seen through holes in the sides and at either end. The pine leaves had all been drawn in by their bases, and the sharp points of the needles had been pressed into the lining

of voided earth. Had this not been effectually done, the sharp points would have prevented the retreat of the worms into their burrows; and these structures would have resembled traps armed with converging points of wire, rendering the ingress of an animal easy and its egress difficult or impossible. The skill shown by these worms is noteworthy, and is the more remarkable, as the Scotch pine is not a native of this district.—DARWIN *Formation of Vegetable Mould*, ch. 2, p. 113. (A., 1882.)

3785. WORMS PREPARE GROUND FOR SEED—*Trituration, Aeration, and Mixing of Soil.*—Worms prepare the ground in an excellent manner for the growth of fibrous-rooted plants and for seedlings of all kinds. They periodically expose the mold to the air, and sift it so that no stones larger than the particles which they can swallow are left in it. They mingle the whole intimately together, like a gardener who prepares fine soil for his choicest plants. In this state it is well fitted to retain moisture and to absorb all soluble substances, as well as for the process of nitrification. The bones of dead animals, the harder parts of insects, the shells of land mollusks, leaves, twigs, etc., are before long all buried beneath the accumulated castings of worms, and are thus brought in a more or less decayed state within reach of the roots of plants. Worms likewise drag an infinite number of dead leaves and other parts of plants into their burrows, partly for the sake of plugging them up and partly as food.

The leaves which are dragged into the burrows as food, after being torn into the finest shreds, partially digested, . . . are commingled with much earth. This earth forms the dark-colored, rich humus which almost everywhere covers the surface of the land with a fairly well-defined layer or mantle.—DARWIN *Formation of Vegetable Mould*, ch. 7, p. 310. (A., 1882.)

3786. WORSHIP OF MAGNETIC NEEDLE IN CHINA—To the magnet the Chinese have always paid divine honors. "An astonishing number of offerings," says the missionary Gutzlaff, "are brought to the magnet; a piece of red cloth is thrown over it, incense is kindled before it, and gold paper, in the form of a Chinese ship, is burned." Barrow also notes that a Chinese navigator not only considers the magnet needle as a guide to direct his track through the ocean, but is persuaded that the spirit by which its motions are influenced is the guardian deity of his vessel.—PARK BENJAMIN *Intellectual Rise in Electricity*, ch. 3, p. 80. (J. W., 1898.)

3787. WORTH OF CULTURE SHOWN BY ITS LACK—*Plants Unimproved among Savages.*—If it has taken centuries or thousands of years to improve or modify most of our plants up to their present standard of usefulness to man, we can understand how it is that neither Australia, the Cape of Good Hope, nor any other region inhabited by quite uncivilized man, has afforded us a single plant worth culture. It is not that these countries, so rich in species, do not by a strange chance possess the aboriginal stocks of any useful plants, but that the native plants have not been improved by continued selection up to a standard of perfection comparable with that acquired by the plants in countries anciently civilized.—DARWIN *Origin of Species*, ch. 1, p. 32. (Burt.)

3788. WRETCHEDNESS OF SAVAGERY—*The Fuegians.*—While going one day [in 1832] on shore near Wollaston Island, we pulled alongside a canoe with six Fuegians. These were the most abject and miserable creatures I anywhere beheld. . . . These poor wretches were stunted in their growth, their hideous faces bedaubed with white paint, their skins filthy and greasy, their hair entangled, their voices discordant, and their gestures violent. Viewing such men, one can hardly make oneself believe that they are fellow creatures, and inhabitants of the same world. It is a common subject of conjecture what pleasure in life some of the lower animals can enjoy: how much more reasonably the same question may be asked with respect to these barbarians! At night five or six human beings, naked and scarcely protected from the wind and rain of this tempestuous climate, sleep on the wet ground coiled up like animals. Whenever it is low water, winter or summer, night or day, they must rise to pick shellfish from the rocks; and the women either dive to collect sea-eggs, or sit patiently in their canoes, and with a baited hair-line without any hook jerk out little fish. If a seal is killed, or the floating carcass of a putrid whale discovered, it is a feast; and such miserable food is assisted by a few tasteless berries and fungi.—DARWIN *Naturalist's Voyage around the World*, ch. 10, p. 212. (A., 1898.)

3789. WRITING ACROSS SPACE—*The Telautograph—Celerity, Accuracy, and Identification.*—In 1893 there was exhibited in the electrical building at the World's Fair an instrument invented by the writer called the telautograph. As the word implies, it is a system by which a man's own handwriting may be transmitted to a distance through a wire and reproduced in facsimile at the receiving end. . . . As one writes his message in one city another pen in another city follows the transmitting-pen with perfect synchronism; it is as tho a man were writing with a pen with two points widely separated, both moving at the same time and both making exactly the same motions. By this system a man may transact business with the same accuracy as by the United States mail, and with the same celerity as by the electric telegraph.

A broker may buy or sell with his own signature attached to the order, and do it

as quickly as he could by any other method of telegraphing, and with absolute accuracy, secrecy, and perfect identification. . . . Companies have been organized both in Europe and America for the purpose of putting the telautograph into commercial use.—ELISHA GRAY *Nature's Miracles*, vol. iii, ch. 19, p. 165. (F. H. & H., 1900.)

3790. WRITING DIVIDES CIVILIZED MAN FROM BARBARIAN—*Makes Accumulation of Knowledge Possible.*—The invention of writing was the great movement by which mankind rose from barbarism to civilization. How vast its effect was may be best measured by looking at the low condition of tribes still living without it, dependent on memory for their traditions and rules of life, and unable to amass knowledge as we do by keeping records of events, and storing up new observations for the use of future generations. Thus it is no doubt right to draw the line between barbarian and civilized where the art of writing comes in, for this gives permanence to history, law, and science.—TYLOR *Anthropology*, ch. 7, p. 179. (A., 1899.)

3791. WRITING, EVOLUTION OF—*At First Imitative—The Hieroglyph—Chinese Picture-writing—Its Shorthand Modern Form.*—From being able to say what he knew, man went on to write what he knew. The evolution of writing went through the same general stages as the evolution of speech. First there was the onomatopœic writing—as it were, the growl-writing—the ideograph, the imitation of an actual object. This is the form we find fossil in the Egyptian hieroglyphic. For a man a man was drawn, for a camel a camel, for a hut a hut. Then intonation was added—accents, that is, for extra meaning or extra emphasis. Then to save time the objects were drawn in shorthand—a couple of dashes for the limbs and one across, as in the Chinese for man: a square in the same language for a field; two strokes at an obtuse angle, suggesting the roof for a house. To express further qualities, these abbreviated pictures were next compounded in ingenious ways. A man and a field together conveyed the idea of wealth, and because a man with a field was rich, he was supposed to be happy, and the same combination stood, and stands to this day, for contentment. When a roof is drawn and a woman beneath it—or the strokes which represent a roof and a woman—we have the idea of a woman at home, a woman at peace, and hence the symbol comes to stand for quietness and rest. Chinese writing is picture-writing, with the pictures degenerated into dashes—a lingual form of the modern impressionism.—DRUMMOND *Ascent of Man*, ch. 5, p. 182. (J. P., 1900.)

3792. WRITING EXTENDS MAN'S HORIZON IN SPACE AND TIME—*Eye-mindedness vs. Ear-mindedness—Accurate Thinking Promoted by Permanence of Visible Symbols.*—Man is an animal who as individual can become a species by acquiring the knowledge and power, the experience and wisdom, of his race. But how limited is this power with the illiterate person! By means of letters one comes to be able to put down his life-experience in written and printed words, and all persons who can read get the power of living over his experience, interpreting the signs which are addressed to the eye and not to the ear. Through letters the person becomes eye-minded, and when a person can read without effort he finds himself in possession of a much more accurate mind than is possible in the case of the illiterate. Ear-mindedness, having to keep up as it does with the spoken word, and having to depend on the memory of what is spoken, cannot critically examine the statements and descriptions, the definitions and deductions, as it can do when it has before it the printed page. In fact, accurate thinking for the most part becomes possible through eye-mindedness and not through ear-mindedness. Then just think of the scope which eye-mindedness attains! It does not depend at all upon the living voice, but it can become participant in the experience of persons at a distance, of all nationalities dwelling in all parts of the world. It is not limited by time. It can make available for its use the writings of all peoples that belong to the historical era, and, in fact, it can use the experience even of the peoples whose only records are monuments and written tablets of the prehistoric era.

Think of the meaning of this for the development of individuality . . . the peculiar index-mark of the nineteenth century! For individuality grows through the appropriation or assimilation of other individuality, and while the ear-minded person can command by means of wealth the services of oral teachers, and gains his instruction through absorbing the lives of his oral teachers, the eye-minded, on the other hand, can command the services of the book, and the book awaits his leisure. All parts of the earth become to him substantially present like his own village. Not merely ordinary teachers come to his service, but the wise men of his race await his leisure in the books which he possesses. These facts about ear-mindedness and eye-mindedness seem trite like a twice-told tale, but few persons are in the habit of thinking what a difference it makes with an entire people to pass from ear-mindedness to eye-mindedness through the beneficent influences of the common schools. . . . As an eye-minded people, with us world gossip has taken the place of village gossip in its hold on our lives.—HARRIS *The Movement from Individualism to Cosmopolitanism (an Address at the National Educational Association, Chicago, Ill., 1900; Proceedings of the Association*, p. 14).

3793. YEARS SHORTEN WITH ADVANCING AGE—*The Novelty of Youth Has Become Routine.*—The same space of time

seems shorter as we grow older—that is, the days, the months, and the years do so; whether the hours do so is doubtful, and the minutes and seconds to all appearance remain about the same. . . . In youth we may have an absolutely new experience, subjective or objective, every hour of the day. Apprehension is vivid, retentiveness strong, and our recollections of that time, like those of a time spent in rapid and interesting travel, are of something intricate, multitudinous, and long drawn out. But as each passing year converts some of this experience into automatic routine which we hardly note at all, the days and the weeks smooth themselves out in recollection to contentless units, and the years grow hollow and collapse.—JAMES *Psychology*, vol. i, ch. 15, p. 625. (H. H. & Co., 1899.)

3794. YIELDING A BETTER PROTECTION THAN HARDNESS—*Flexible Buildings Best Withstand Earthquakes.*—From [an examination of] the different buildings found in earthquake countries, it will be seen that if we wish to put up a building able to withstand a severe shaking we have before us structures of two types. One of these types may be compared with a steel box, which, even were it rolled down a high mountain, would suffer but little damage; and the other, with a wicker basket, which would equally withstand so severe a test. Both of these types may be, to some extent, protected by placing them upon a loose foundation, so that but little momentum enters them at their base.

One suggestion is to place a building upon iron balls. The author found that the most practical form of free foundation was to rest the building upon layers of cast-iron shot, each shot being about one-quarter inch in diameter. Another method would be to place them upon two sets of rollers, one set resting upon the other set at right angles. The sole-plates of a Japanese house rest freely on more or less rounded stones. The solid type of building is expensive, and can only be approached partially, whilst the latter is cheap, and can be approached closely. In the case of a solid building it would be a more difficult matter to support it upon a movable foundation than in the case of a light framework. Such a [solid] building is usually firmly fixed on the ground, and consequently at the time of an earthquake, as has already been shown by experiment, must be subjected to stresses which are very great. In consequence also of the greater weight of the solid structure, the effects due to its own inertia will be augmented. Also, we must remember that the rigidity favors the transmission of momentum, and with rigid walls we are likely to have ornaments, coping-stones, and the comparatively freer portions forming the upper part of a building displaced; whilst, with flexible walls, absorbing momentum in the friction of their various parts, such disturbances would not be so likely.—MILNE *Earthquakes*, ch. 7, p. 127. (A., 1899.)

3795. ——— ——— *Tracery of Fine Fabrics on Glass.*—By protecting certain portions of the surface [of glass, from the sand-blast], and exposing others, figures and tracery of any required form could be etched upon the glass. The figures of open iron-work could be thus copied; while wire-gauze placed over the glass produced a reticulated pattern. But it required no such resisting substance as iron to shelter the glass. The patterns of the finest lace could be thus reproduced; the delicate filaments of the lace itself offering a sufficient protection. All these effects have been obtained with a simple model of the sand-blast devised by my assistant. A fraction of a minute suffices to etch upon glass a rich and beautiful lace pattern. Any yielding substance may be employed to protect the glass. By diffusing the shock of the particle such substances practically destroy the local erosive power. The hand can bear, without inconvenience, a sand-shower which would pulverize glass. Etchings executed on glass with suitable kinds of ink are accurately worked out by the sand-blast. In fact, within certain limits, the harder the surface the greater is the concentration of the shock, and the more effectual is the erosion. It is not necessary that the sand should be the harder substance of the two; corundum, for example, is much harder than quartz; still, quartz-sand can not only depolish, but actually blow a hole through a plate of corundum.—TYNDALL *Fragments of Science*, vol. i, ch. 7, p. 193. (A., 1897.)

3796. YOUTH AND AGE, GEOLOGICAL—Such, then, are the several stages through which a region of mountain-uplift must pass. First comes the stage of youth, when the surface configuration corresponds more or less closely with the underground structure. Next succeeds the stage of middle life, when such coincidence is all but obliterated, when the valleys of youth have been exalted and its mountains have been laid low. Last comes old age and final dissolution, when the whole region has been reduced to its base-level.—GEIKIE *Earth Sculpture*, ch. 5, p. 125. (G. P. P., 1898.)

3797. YOUTH THE PERIOD FOR FORMING PERSONAL HABITS—*Character Plastic before Twenty.*—If the period between twenty and thirty is the critical one in the formation of intellectual and professional habits, the period below twenty is more important still for the fixing of personal habits, properly so called, such as vocalization and pronunciation, gesture, motion, and address. Hardly ever is a language learned after twenty spoken without a foreign accent; hardly ever can a youth transferred to the society of his betters un-

learn the nasality and other vices of speech bred in him by the associations of his growing years. Hardly ever, indeed, no matter how much money there be in his pocket, can he even learn to dress like a gentleman born. The merchants offer their wares as eagerly to him as to the veriest "swell," but he simply cannot buy the right things. An invisible law, as strong as gravitation, keeps him within his orbit, arrayed this year as he was the last; and how his better-bred acquaintances contrive to get the things they wear will be for him a mystery till his dying day.—JAMES *Psychology*, vol. i, ch. 4, p. 121. (H. H. & Co., 1899.)

3798. ZERO-SIGN, VALUE OF—*Great Advance in Mathematics Due to a Sign for Nothing.*—[The] invention of a sign for nothing was practically one of the greatest moves ever made in science. It is the use of the zero which makes the difference between the old arithmetic and our easy ciphering. We give the credit of the invention to the Arabs by using the term Arabic numerals, while the Arabs call them Indian, and there is truth in both acknowledgments of the nations having been scholars in arithmetic one to the other. But this does not go to the root of the matter, and it is still unsettled whether ciphering was first devised in Asia, or may be traced further back in Europe to the arithmeticians of the school of Pythagoras. As to the main point, however, there is no doubt that modern arithmetic comes out of ancient counting on the columns of the abacus, improved by writing a dot or a round O to show the empty column, and by this means young children now work calculations which would have been serious labor to the arithmeticians of the ancient world.—TYLOR *Anthropology*, ch. 13, p. 315. (A., 1899.)

3799. ZONE, ABYSMAL—*The Lowest Depths of the Great Oceans—The Unknown Realm That Yet Baffles Science.*—The last well-marked zone is the abysmal, extending from the 500-fathom line to the greatest depths of the ocean, one of enormous superficial area, one that it is most difficult to investigate, and one about which we know but little. In the present state of our knowledge we cannot divide it into any well-marked subzones, nor even into geographical regions or subregions. It is not divided into sections by any important geographical barriers, and the general characters presented by its fauna are practically the same all the world over.—HICKSON *Fauna of the Deep Sea*, ch. 3, p. 50. (A., 1894.)

3800. ZONES, TEMPERATE, THE CHIEF ABODES OF LIFE—The astronomical contrast between the north and the south divides distinctly the different parts of the world into two separate groups. Almost the whole extent of the three northern continents belongs to the temperate zone, and it is only their most advanced peninsulas which are pushed forward—on the one side into the frigid, and on the other into the torrid zone. With regard to the three southern continents, they present their chief development between the tropics or in the south temperate zone. They receive the greatest amount of annual heat, and consequently become the theater of the most remarkable phenomena of planetary vitality. There the cross action of the winds and rains between the two hemispheres takes place, and hurricanes take their rise; there immense deserts extend over vast areas; there, too, vegetation manifests all its productive energy, and the terrestrial fauna attains its greatest force and its highest beauty.—RECLUS *The Earth*, pt. ii, ch. 10, p. 75. (H., 1871.)

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